Vol. 10, No. 12
June 30, 1985

Energy Research Abstracts

Abstracts 22272-23378

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription (use PB85-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic (North America) or $28.00 for foreign (outside North America); a single issue is $8.00 or $16.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB85-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers; a single issue is $7.00 and $14.00, respectively.

***Current Energy Patents (CEP)*–PB85-902800**

Devoted to international patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB85-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB85-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB85-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB85-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic (North America) and $80.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB85-901000**

Covers all aspects of acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB85-900700**

Covers worldwide information on the technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB85-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB85-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB85-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB85-900600**

Covers worldwide information on all aspects of biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB85-914700**

Covers information on the exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*– PB85-900500**

Covers all aspects of heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB85-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB85-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB85-913500**

Covers the safety aspects of accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB85-902900**

Covers the management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB85-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB85-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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The 1984 Annual Indexes of *Energy Research Abstracts* (Volume 9) are available on microfiche. The five indexes may be ordered separately or as a set via the following codes and order numbers.

Index	Code	Price	Order No.
1. Corporate Author	A01	$4.50	DE85012278
2. Contract Number	A01	$4.50	DE85012279
3. Report Number and File No. Correlation	E01	$6.50	DE85012280
4. Personal Author	E01	$6.50	DE85012281
5. Subject	E03	$9.50	DE85012282
6. Set (all 5 indexes)	E10	$23.50	DE85012283

DOE offices and contractors may order from the DOE Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; others should order from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

AND

Printed copies of the indexes are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The price of the set is $83.00, and the sales stock number is S/N 061-000-00657-5.

energinfo ERA

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00657-5 and the price is $83.00 for the Vol. 9 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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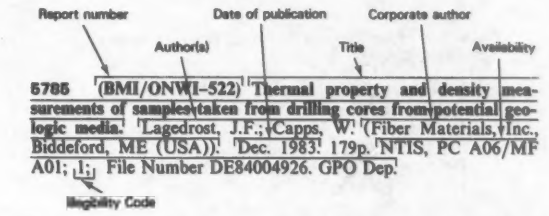
United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831

HOW TO USE *ENERGY RESEARCH ABSTRACTS*

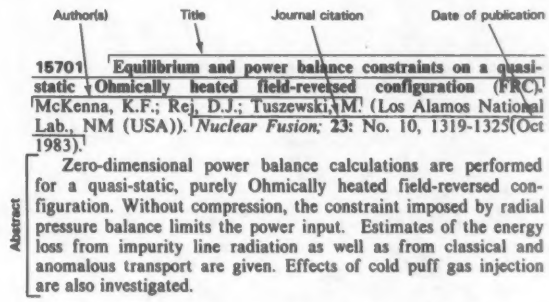
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23**: No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	**9:5785**	**NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70**

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Much of the information is provided by (1) bilateral exchange agreements with foreign organizations, and (2) exchange agreements or contracts with other U. S. government agencies, private firms, or institutions.

Foreign Sources

CEA Centre d'Etudes de Saclay
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Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
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Oak Ridge, TN

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Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 39 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semi-monthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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01 COAL AND COAL PRODUCTS

22272 (DOE/NBM—5009454) Summary of university contracts and grants supported by the Office of Fossil Energy, FY 1984. (Burns and Roe Services Corp., Pittsburgh, PA (USA); Science Applications International Corp., Pittsburgh, PA (USA)). 1984. 445p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85009454.

This book is a compilation of summaries of research contracts and grants at universities supported by the Office of Fossil Energy in FY 1984. The summaries consist of one-page fact sheets for each contract or grant providing business information, research objectives, statement of work and major accomplishments. These contracts and grants are classified by research and development category as signified by DOE's budget and reporting number. Within each category, the contracts and grants are arranged alphabeticaly and successively by state, city, university and contract number. Indices are provided.

22273 (DOE/NBM—5009475) Summary of AR and TD/APT contracts and grants supported by the Office of Fossil Energy FY 1984. (Burns and Roe Services Corp., Pittsburgh, PA (USA); Science Applications International Corp., Pittsburgh, PA (USA)). 1984. 317p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85009475.

This book is a compilation of summaries of research contracts and grants supported by the Office of Fossil Energy in FY84 under the following two programs: Advanced Research and Technology Development (AR & TD), and Advanced Process Technology (APT). The summaries consist of one-page fact sheets for each contract or grant providing business information, research objectives, statement of work and major accomplishments.

22274 (IPD-ISO—1011) Chemical and materials engineering for industry - divisional annual report 1983-1984. Palmer, E.R. (ed.). (Department of Scientific and Industrial Research, Petone (New Zealand). Industrial Processing Div.). Aug 1984. 47p. Department of Scientific and Industrial Research, Industrial Processing Division, Petone, New Zealand.

This report presents an overview of the Industrial Processing Division's activities during 1983/84 as well as brief descriptions of research and development projects. Those of interest include pyrolysis of New Zealand coals, hydrotreating of coal tars and coal-derived liquids, utilization and pelletization of coal fines, paper-bonded coal briquets, pulverized fuel applications, coal-oxygen combustion, cleaning of Webb coal, and coke production.

22275 (NRCC—23014) The Technical Research Centre and the peat industry in Finland. Sheppard, S. (National Research Council of Canada, Halifax, Nova Scotia). 1984. 110p. National Research Council of Canada, Halifax, Nova Scotia.

Based on observations, conversations and reports collected during a 3-months working visit to Finland in Summer 1983 briefly details (a) commercial operations - small sod machine development by Suokone Oy; moisture metering and pelletizing by Turveruukki Oy; VAPO peat coke factory at Haukineva; Tampere milled peat fired power station and VAPO peat production and (b) peat research at VTT, including production, handling and storage, dewatering, combustion, testing and standards, liquefaction, gasification and hydrolysis.

0104 Processing

REFER ALSO TO CITATION(S) 01040022274, 22305, 22314, 22321, 22321, 22327, 22352, 22357, 22357, 22477

22276 (ANL/AA—31) Decision-analytic framework for portfolio selection: choosing among supplemental environmental research projects proposed for the Great Plains Coal Gasification Facility. Peerenboom, J.P.; Buehring, W.A.; Joseph, T.W. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 86p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009984.

This report describes the development and application of a hierarchical decision-analytic framework for selecting a portfolio of research and development projects. A US Department of Energy steering committee used the framework to develop a comprehensive and defensible $12 million Supplemental Environmental Program (SEP) for the Great Plains Coal Gasification Facility. This decision problem was characterized by: (1) five technical subcommittees that proposed detailed studies addressing different environmental and health issues; (2) many combinations of proposed studies that satisfied the $12 million budgetary constraint; (3) multiple objectives that required value tradeoffs at both the committee and subcommittee levels; and (4) uncertainties about research needs, data availability, and costs. The framework for determining funding (study) priorities used the principles of decision analysis to divide the overall SEP problem into a series of smaller subproblems tailored to the specific organizational structure of the steering committee and its five subcommittees. A dynamic optimization procedure was used to compare alternative funding strategies; the strategies were ranked on the basis of their expected utility, as calculated with a multiattribute utility function. Each subcommittee chairman was directly responsible for ranking the studies proposed by his subcommittee and, on the basis of that ranking, quantifying the degree to which the proposed research plan met objectives established for the entire SEP by the steering committee chairman. The approach is applicable to similar portfolio selection problems in both the public and private sectors.

22277 (DOE/FC/10620—01) Pulsating gasification of low rank coals. Quarterly technical progress report, September 15-December 31, 1984. Zinn, B.T.; Powell, E.A.; Narayanaswami, L.L. (Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering). Dec 1984. Contract AC18-84FC10620. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008226.

The conservation equations for the pulsating gasifier have been presented and discussed in the research proposal. To solve them, the sources of mass, momentum and energy appearing in these equations must be specified by an auxiliary set of equations. The development of these auxiliary equations requires the modeling of the various processes that occur in the gasifier. They include: (1) the unsteady coal combustion, (2) the radiative interchange in the gasifier, and (3) the convective and conductive interchange among the gases, particles and gasifier walls. Part of the research effort has been directed toward the modeling of the coal reaction processes. Studies conducted to date with pulsating combustors indicate that the presence of oscillations results in advantages such as high combustion intensity, high combustion efficiency, high convective heat transfer rates to fuel particles and heat transfer surfaces, and ability to keep heat transfer surfaces clean due to the scrubbing-like action of the oscillating flow. While these advantages are also likely to enhance the operation of pulsating gasifiers, only two studies of coal gasification under pulsating conditions have been conducted to date. Neither provided, however, sufficient information which

could be used as a guide in the design of future pulsating gasifiers. The present research has been undertaken with the objective of developing a theoretical model which could be used to guide (and hopefully optimize) the design of pulverized coal gasifiers. 17 references.

22278 **(DOE/FE/60181—132) Pilot-scale treatment and cooling tower reuse of gasification wastewater.** Galegher, S.J.; Mann, M.D.; Willson, W.G.; Mayer, G.G.; Hendrikson, J.G. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Mar 1985. Contract FC21-83FE60181. 13p. (CONF-850427—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009784.

From Western synfuels symposium; Grand Junction, CO, USA (24 Apr 1985).

The principal goal of the gasification research program at the Univerity of North Dakota Energy Research Center (UNDERC) is to develop environmental data for effluent streams for fixed-bed gasification processes using low rank coals (LRC). Current efforts involve the treatment of gas liquor wastewater streams, and subsequent reuse in process cooling towers. The relatively large volume of wastewater produced in the fixed-bed gasification of LRC's makes the reuse of this stream in an evaporative cooling tower a desirable approach. However, the use of gas liquor as cooling tower makeup presents both operating and environmental concerns. At UNDERC a series of cooling tower wastewater reuse tests have been performed using water pretreated to various degrees. Wastewater for each test was produced in a pilot slagging fixed-bed gasifier (SFBG) at UNDERC using North Dakota lignite from the Indian Head mine. During the first phase of testing SFBG wastewater was treated by solvent extraction and steam stripping, to reduce levels of phenolic compounds and ammonia, prior to use as makeup to a pilot mechanical draft cooling tower. In later tests, this extracted and stripped wastewater (SGL) was further treated by biological oxidation and by granular activated carbon adsorption in pilot equipment at UNDERC before being fed to the cooling tower. The final test in this series involved the use of this extensively treated wastewater with the addition of chemical corrosion and scale inhibitors as cooling tower makeup. High carbon steel corrosion rates, biological and organic fouling rates, foaming, and volatile organic stripping rates were observed in the test using stripped gas liquor from slagging fixed-bed gasification.

22279 **(DOE/FE/60339—T11) Extraction and desulfurization of chemically degraded coal with supercritical fluids. Final report, July 1, 1983-December 1984.** Chen, J.W.; Muchmore, C.B.; Kent, A.C. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Mar 1985. Contract FC22-83FE60339. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009119.

This report describes the progress made in the research entitled "Extraction and Desulfurization of Chemically Degraded Coal with Supercritical Fluids." The desulfurization of coal, employing ethanol or methanol as solvent under supercritical conditions, has demonstrated its ability to selectively remove sulfur from the coal matrix. The objectives of the research are these: (1) to obtain rate data for supercritical extraction and desulfurization of coal, and to determine the desulfurization selectivity ratio for various coals; (2) to study the effect of chemical pretreatment of coal on desulfurization potential; and (3) to determine the characteristics of the desulfurized solid char and to measure and evaluate the liquid and gaseous streams. The experimental investigations have been carried out in two reactor systems, a semicontinuous reactor and a batch reactor. Experimental data obtained have indicated the following achievements: (1) the extraction and desulfurization of coal with supercritical ethanol is first order in nature, and the activation energies for coal extracted and sulfur removed are 30.3 and 21.0 Kcal, respectively; (2) the desulfurization selectivity ratio is found to be between 2.96 to 4.38 for four Illinois coal samples studied; (3) the effect of KOH pretreatment indicates an improvement of supercritical desulfurization potential; and (4) the evalution of product streams reveals that supercritical desulfurization generates a high Btu gas and coal-derived liquid in addition to the desulfurized solid product. 2 references, 5 tables, 9 figures.

22280 **(DOE/MC/16545—1666) Coal gas desulfurization at high temperatures. Status of METC investigations.** (Science Applications, Inc., Morgantown, WV (USA)). Oct 1984. Contract AC21-81MC16545. 338p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85003382.

This report, which consists of data only, documents the continuing effort at the US Department of Energy/Morgantown Energy Technology Center (METC) develop a hot gas desulfurization (HGD) process for coal-derived gas. Previous reports have documented the testing of metal oxide sorbents on lab-scale test equipment. These tests were supported by thermodynamic calculations to determine the equilibrium levels of H_2S attainable with metal oxide sorbents at high temperatures. Early testing of iron oxide and zinc oxide sorbents led to the development of a zinc ferrite ($ZnFe_2O_4$) sorbent. Zinc ferrite was shown to be regenerable and capable of lowering the sulfur level in hot (1000 to 1200°F) coal derived gas to less than 10 ppM. A skid-mounted test unit was designed, fabricated, and installed on a sidestream of the DOE/METC fixed bed gasifier. Four series of tests were conducted during four gasifier runs between June 1983 and December 1983. The zinc ferrite based hot gas desulfurization process was on stream a total of 341 hours during 13 sulfidations. Nine regenerations were also conducted, adding an additional 169 hours to the total run time. The fixed bed gasifier supplying gas to the hot gas desulfurization test unit was fed various coals during these tests. Oxidant to the gasifier was air for the most part, but there were periods of oxygen blown operation. Performance of the Zinc Ferrite Hot Gas Desulfurization Test Unit was generally good. Sulfur levels in the coal gas was generally lowered below 10 ppM. Some carbon deposition was experienced in the HGD reactor. However, this was removed during regeneration. Due to variations in gasifier operating conditions and HGD operating conditions, long-term operating characteristics were not determined. 15 references, 7 figures, 5 tables.

22281 **(DOE/MC/19163—1776) Great Plains ASPEN model development: ASPEN sizing enhancements. Final topical report.** Schwint, K.J. (Scientific Design Co., Inc., New York (USA)). Feb 1985. Contract AC21-82MC19163. 122p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85003384.

In preparing cost estimates for the various sections of the Great Plains Coal Gasification Plant, the equipment sizing methods for the major equipment items were checked. The sizing results obtained from ASPEN were compared with the sizing results obtained by using the Halcon SD Group's (HSD) own sizing methods and in-house computer programs. Where there were significant differences between the ASPEN sizing results and our own results, the subroutine coding was checked to determine where the differences arose. Modifications were then made to the ASPEN routines where it was thought that HSD's methods would significantly enhance the quality of ASPEN. The following ASPEN sizing subroutines were modified: (1) STW01 - ASPEN tray tower sizing; (2) SVS11 - ASPEN vertical vessel sizing; (3) SVS01 - ASPEN horizontal vessel sizing; and (4) CPVVTH - ASPEN vertical vessel/tower shell thickness and weight determination. Modifications were made to sizing calculations contained in the following ASPEN COST subroutines: (1) CPC01 - ASPEN centrifugal pump costing; and (2) CPC02 - ASPEN centrifugal compressor costing. Modifications also were made to sizing calculations contained in the following ASPEN UOS subroutines: (1) UPC01 - ASPEN pump model; and (2) UPC02 - ASPEN compressor model. A new ASPEN COST subroutine that contains sizing calculations was developed, CPC04 - ASPEN reciprocating compressor costing. 4 references.

22282 **(DOE/MC/19163—1777) Great Plains ASPEN model development: Stretford Sulfur Recovery Plant. Final topical report.** Daniel, S.M.; Stern, S.S. (Scientific Design Co., Inc., New York (USA)). Feb 1985. Contract AC21-82MC19163. 571p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE85003383.

An ASPEN model has been developed of the Stretford Sulfur Recovery, Section 4000, of the Great Plains Gasification Plant. The bases for this model are the process description given in Section 3.4.13 of the Great Plains Project Management Plan, and

Lummus flowsheet E-7102-250-3. In the Stretford process, H2S is dissolved in an aqueous solution containing a reducing agent that reduces the H2S to sulfur. The solution is buffered with sodium carbonate. The vapor-liquid equilibrium involves ionic species. Because ionic equilibrium calculations are unavailable in ASPEN, except in the FLASH block, the model treats the two absorbers as two SEP blocks. A second model also was prepared with ten flash stages using ionic equilibrium. This model can be used to predict the H2S recovery in the absorbers, and the recovery factor then can be used in the overall model. The ASPEN model that has been developed calculates the material and energy balances of the entire flowsheet, and the equipment duties for a given set of process conditions. The entire set of gasifier raw gas components is used. The K-values for all of the flash blocks are calculated using the Peng-Robinson equation of state, modified for water. Values of the parameters for the gases in water were subjected to regression analysis, and included in the insert file PRKIJ. Because of the lack of data, no consideration was given to the effect on solubility of the ionic species. Table 10 summarizes the design basis used in the simulation. The overall model, in its present form, is unable to predict changes in process conditions that would result from load changes on equipment of fixed sizes. The model can be used to simulate the steady-state operation of the plant, at or near design conditions, or to design other Stretford sulfur removal plants. 24 references, 12 tables.

22283 (DOE/MC/19163—1779) Great Plains ASPEN model development: Phosam section. Final topical report. Stern, S.S.; Kirman, J.J. (Scientific Design Co., Inc., New York (USA)). Feb 1985. Contract AC21-82MC19163. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85003386.

An ASPEN model has been developed of the PHOSAM Section, Section 4600, of the Great Plains Gasification Plant. The bases for this model are the process description given in Section 6.18 of the Great Plains Project Management Plan and the Lummus Phosam Schematic Process Flow Diagram, Dwg. No. SKD-7102-IM-O. The ASPEN model that has been developed contains the complete set of components that are assumed to be in the gasifier effluent. The model is primarily a flowsheet simulation that will give the material and energy balance and equipment duties for a given set of process conditions. The model is unable to predict fully changes in process conditions that would result from load changes on equipment of fixed sizes, such as a rating model would predict. The model can be used to simulate the steady-state operation of the plant at or near design conditions or to design other PHOSAM units. Because of the limited amount of process information that was available, several major process assumptions had to be made in the development of the flowsheet model. Patent literature was consulted to establish the ammonia concentration in the circulating fluid. Case studies were made with the ammonia content of the feed 25% higher and 25% lower than the base feed. Results of these runs show slightly lower recoveries of ammonia with less ammonia in the feed. As expected, the duties of the Stripper and Fractionator reboilers were higher with more ammonia in the feed. 63 references.

22284 (DOE/MC/19163—1780) Great Plains ASPEN model development: Rectisol Plant. Final topical report. Kirman, J.J.; Stern, S.S. (Scientific Design Co., Inc., New York (USA)). Feb 1985. Contract AC21-82MC19163. 302p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85003387.

An ASPEN model has been developed of the Rectisol Plant, Section 1400. The basis for this model is the process description given in Section 6.10 of Great Plains Project Management Plan, and the Lummus Rectisol Schematic Flow Diagram, Dwg. No. SK D-7102-IE-2. Published literature and commercial brochures distributed by the Lotepro Corp. also were used. The Rectisol plant simulation is divided into two models: (1) a Main Sequence for the absorption, flash regeneration, hot regeneration, and gas scrubbing operation, and (2) a Methanol Recovery Sequence for the multiple flashing and distillation trains for the recovery of methanol from two major effluent streams from the Main Sequence. The model for the Main Sequence is rather robust. This is exemplified by several case studies wherein seven parameters were varied without changing the initial guesses, and a series of converged results were obtained for all runs. These case studies concerned: H_2S in feed gas, H_2S concentration in the off gas, H_2S concentration in the bottoms of the Hot Stripper, flow rate of the flash-regenerated intermediate methanol, temperature of the lean methanol, moisture specification for the vapor from the prewash section, and separation factors for the operations of the Methanol Recovery Section. The Methanol Recovery Sequence model is not particularly robust with respect to the distillation blocks. Care must be applied in specifying the values (reflux ratios, bottoms or distillate flow rates, recovery fractions, etc.) used in the COL-SPEC or FORTRAN control blocks to avoid conditions for which convergence is difficult or impossible. Significant amounts of methanol are left in the effluent streams; this indicates a need for optimization. Of particular note is the failure of the simulation to predict the existence of two liquid phases in the third flash that is labelled as Naphtha Extractor in the Lummus flowsheet. 64 references.

22285 (DOE/MC/19163—1786) Great Plains ASPEN model development: development of a model for the density of solutions of aqueous electrolytes. Final topical report. Dweck, J.S.; Mendelson, M.A.; Blumenfeld, R. (Scientific Design Co., Inc., New York (USA)). Jan 1985. Contract AC21-82MC19163. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003390.

A new physical property model for the calculation of the density of solutions of aqueous electrolytes has been developed for the ASPEN process simulator as part of the simulation of the Great Plains Coal Gasification Plant. The model developed recently by Jay S. Dweck, Consultant, Inc. is an extension of the Debye-Huckel limiting law. The Debye-Huckel limiting law allows the predictions of the density of dilute solutions of dissolved salts by providing a relationship for the molar volume of the salt as a function of ion strength. The relationship is linear in the square root of ionic strength, with the slope dependent only upon the charges of the ions which constitute the salt. When combined with data for the infinite dilution molar volume of the salts, solution density can be calculated. The new model preserves the linear relationship with the square root of ionic strength, but introduces ion dependent parameters for the determination of the slope. The solution density is calculated in terms of the molar volumes of the individual ions, instead of a mixture of pseudo salts. Preliminary tests of the model have shown it to be far more accurate than the original limiting law, and applicable to more concentrated solutions (greater than 10 molar).

22286 (DOE/PC/40784—T6) Dependence of liquefaction behavior on coal characteristics. Part VIII. A chemical study of the asphaltenes from the liquefaction of coal. Concluding remarks for this series of reports. Final technical report, March 1981-March 1985. Shadle, L.J.; Given, P.H. (Pennsylvania State Univ., University Park (USA)). Mar 1985. Contract AC22-81PC40784. 260p. NTIS, PC A12/MF A01; GPO Dep. File Number DE85009130.

The chemistry of asphaltenes was studied in an attempt to determine the influence of coal characteristics on the composition of the liquefaction products. Forty coals were liquefied in tetralin and the coals and asphaltenes were studied using spectroscopic, oxidative degradative, and derivatization techniques. A suite of 26 high-sulfur coals was selected to provide a homogeneous set with which to evaluate the relationships between coals and asphaltenes using bivariate and multivariate statistical techniques. Other coals studied were from 5 different geologic provinces; these had low sulfur contents, and several exhibited notably high hydrogen contents. Nuclear magnetic resonance was used to obtain carbon and hydrogen distributions, and infrared analysis was used to attain additional information on functional groups. Oxidation with trifluoroperoxyacetic acid was used to study hydrogen-rich structures, and the reaction was modified to better preserve primary oxidation products such as citraconic, homophthalic, cyclohexene dicarboxylic, and long-chain alkanoic acids. The asphaltenes from the high-sulfur coals were structurally homogeneous, since the range of variability was quite narrow in terms of the structural and compositional parameters. The carbon and oxygen contents of the asphaltenes varied linearly with coal rank parameters. This was also evident in the low-sulfur coals that were studied. However, the structural parameters obtained from the spectroscopic analyses and oxi-

dative degradation of asphaltenes could not be statistically related to coal properties or behavior. The principal coal properties which influenced the chemical composition of asphaltenes were related to coal rank and petrology; however, other geologic considerations such as weathering and an accelerated rate of coalification also affected asphaltene structure. 10 references, 26 figures, 36 tables.

22287 (DOE/PC/40792—T4) Design of a small particle sampling system. Progress report. Chu, C.J.; Fredin, L.; Hauge, R.H.; Margrave, J.L. (Rice Univ., Houston, TX (USA). Dept. of Chemistry). [1985]. Contract FG22-81PC40792. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005908.

The objective of present studies is the identification of gaseous species resulting from the rapid pyrolysis of small coal particles in vacuum and in the presence of reactive gases. Emphasis is placed on the early steps of coal gasification where highly reactive gas phase intermediate species can be observed by rapidly heating the coal to reaction temperature and then trapping the gaseous products with an inert gas on a cold (15K) surface. Identification and characterization of these gaseous species and possibly free radicals are performed using matrix isolation FTIR and high resolution mass spectroscopy, therefore, only a small amount of sample is required. In order to achieve this small sampling requirement, it became necessary to develop a flexible small particle sampling system. The following presents an account of the coal sampling systems we have developed during the course of our studies. Initial coal sampling apparatus designs as well as a more extensive discussion on our final design which meets all of our sampling requirements will be described. The final, microgram transient pulsed flow, small particle coal sampling system has proved to be a very useful means of metering small amounts of coal of a known particle size and weight into a reactor. It may also be of use to other investigations with a need to repeatably and reproducibly inject a known small amount of a solid sample into a reactor. 1 reference, 4 figures, 2 tables.

22288 (DOE/PC/50041—48) Wilsonville Advanced Coal Liquefaction Research and Development Facility, Wilsonville, Alabama. Topical report No. 6, CSD unit - operation and maintenance, 1983. (Catalytic, Inc., Wilsonville, AL (USA)). Mar 1985. Contract AC22-82PC50041. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009865.

A summary of the 1983 Critical Solvent Deashing unit performance at the Wilsonville Advanced Coal Liquefaction R and D Facility is presented. All periods of on feed operation, unscheduled shutdowns, and scheduled shutdowns are accounted for and tabulated. Causes of unscheduled shutdowns are identified and discussed. Details of repeated, major maintenance problems with various pieces of equipment are presented. Where applicable, solutions are discussed. Historical operations and maintenance data are presented and used for comparison purposes in order to better indicate areas of improvement in the unit. 4 references, 7 figures, 3 tables.

22289 (DOE/PC/60047—T6) Advanced research for the characterization of hydrogen donor solvents in two-stage liquefaction. Quarterly report, October 1-December 31, 1984. Chillingworth, R.S.; Potts, J.D. (Cities Service Research and Development Co., Tulsa, OK (USA)). 1985. Contract AC22-83PC60047. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008132.

The purpose of this research program is to develop an improved method for producing a highly effective solvent for the Integrated Two-Stage Liquefaction (ITSL) process and to study the characteristics of the solvent at a variety of process conditions. The ITSL process for conversion of coal to distillate liquids combines Short Contact Time (SCT) hydroliquefaction and expanded bed hydrogenation and hydrocracking of the coal extract, either before or after deashing. Experimental microautoclave work in Subtask 2.3 (solvent hydrocracking with catalysts) was completed. A total of fourteen catalysts were tested from which six were chosen for further evaluation in Subtask 3.2. The six catalysts are: Shell 324 Mod. Ni/Mo; Shell 317 Ni/Mo; American Cyanamid Beaded Co/Mo; Katalco NM-506 Ni/Mo; American Cyanamid 1442B Co/Mo; and Procatalyse HT-841 Ni/Mo. Scheduled microautoclave work in Subtask 3.2 (coal extract and solvent hydrogenation) was completed. Initial results show that the quality of the hydrogenated product, based on hydrogen content, depends primarily on the hydrogen content of the SCT paste solvent which made the extract feedstock to Subtask 3.2. The choice of catalyst in the hydrotreater and the severity of the SCT extract production step were of lesser significance to the quality of the hydrogenated product. The catalytic reactor conditions also are of great importance in product quality and may be used to adjust the hydrogen content of an insufficiently hydrogenated or overly hydrogenated recycle paste solvent stream. 2 figures, 10 tables.

22290 (DOE/PC/60800—T3) Active sites in char gasification. Fourth quarterly progress report, July-September, 1984. Suuberg, E.M.; Calo, J.M.; Wojtowicz, M.; Lilly, W. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1984. Contract FG22-83PC60800. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007880.

The subject of this research is the origin, nature, and fate of active sites in chars derived from parent hydrocarbons with coal-like structure. The highly crosslinked, phenol-formaldehyde resins described in detail in the third quarterly report are again the subject of this report. Details of the curing process were given in that report and are employed here, except that the final stage of curing involves two hours at 300°C rather than at 400°C as previously used. It is important to emphasize that the curing methodology employed in this study (in which there is a long period of low temperature heat soak) apparently crosslinks the resin to the extent that there is no development of the glassy carbon texture obtained by pyrolyzing raw resin immediately at higher temperatures. This fact should be kept in mind when examining the surface areas of the chars, which are considerably in excess of those seen with the more glassy chars reported by some workers. Measurements performed on the resin reported here involve: oxygen chemisorption, as a function of pyrolysis conditions and chemisorption conditions; total surface areas, by N_2 adsorption; and gas desorption. 6 references, 1 table.

22291 (DOE/PC/70787—T2) Supercritical water based liquefaction. Quarterly report No. 1, September 15-December 14, 1984. Stenberg, V.I. (North Dakota Univ., Grand Forks (USA)). 1984. Contract FG22-84PC70787. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008657.

In 1978, we first found evidence in our reactors that H_2S was active in promoting the conversion of coal related model compounds into fragmented molecules. In 1984, we began using H_2O-H_2S as a substitute for organic, hydrogen donor pasting solvents for coal liquefaction. The philosophy for its use as a substitute for organic slurrying solvent is that the water fulfills the role of the slurrying liquid and H_2S is the hydrogen atom donor. The data of Table 1 compare the H_2O-H_2S results along with those using: (1) a petroleum-coal based organic solvent, anthracene oil (AO4) together with a solvent refined coal middle distillate from the demonstration plant at Tacoma, Washington (SRCMD); and (2) dihydrophenanthrene (DHP), a reputedly excellent hydrogen donor solvent. One rank of coal is represented in the data. Water with synthesis gas equal the performance of AO4-SRCMD with synthesis gas for the conversion of two coal samples into volatile materials at the conditions used. The presence of a small amount of H_2S enhances the as-defined yields whether in water, or in an organic solvent. In one case with H_2, no enhancement occurred. The reactions which had the temperature programmed from 300°C to 500°C using H_2O-H_2S and synthesis gas gave the best of the aqueous-H_2S conversion yields. Synthesis gas is superior to pure H_2 (980 psig). The dihydrophenanthrene (DHP) runs gave better conversions than either water or AO4-SRCMD given otherwise the same experimental conditions. However, DHP decomposes to the extent of 11% at 420°C at 30 minutes, and the non-gaseous products are solids rather than liquids as they are with the water runs. The water runs were the easiest to separate from the product slurry. 11 references, 3 figures, 1 table.

22292 (EPRI-AP—3825-SR) Ninth annual EPRI contractors' conference on coal liquefaction: proceedings. (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1985. 901p. (CONF-8405302—). Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $64.00. File Number TI85920574.

From 9. annual EPRI contractors' conference on coal liquefaction; Palo Alto, CA, USA (8 May 1984).

EPRI's Ninth Annual Coal Liquefacton Conference was held on May 8, 9, and 10, 1984 in Palo Alto, California. The conference featured results of tests which combusted synthetic fuels in utility boilers and turbines, as well as many papers on technology development. Specific presentation areas were as follow: (1) two-stage liquefaction process development in the United States and Japan; (2) operation of the 200-t/d pilot plant in Bottrop, Federal Republic of Germany; (3) combustion of coal-derived liquids; (4) methanol sythesis; (5) utilization of coal liquefaction residues for gasification and combustion; and (6) coal science. Thirty-six papers in the Proceedings have been processed for inclusion in the Energy Data Base.

22293 (EPRI-AP—3980) Evaluation of the British Gas Corporation/Lurgi slagging gasifier in gasification-combined-cycle power generation. Final report. delaMora, J.A.; Grisso, J.R.; Klumpe, H.W.; Musso, A.; Roszkowski, T.R.; Thompson, B.H.; Lienhard, H.; Beyer, T. (Parsons (Ralph M.) Co., Pasadena, CA (USA); British Gas Corp., London; Lurgi Apparate-Technik G.m.b.H., Frankfurt am Main (Germany, F.R.)). Mar 1985. 183p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $17.50. File Number TI85920577.

Plant designs, performance data, cost estimates, and bus-bar power costs were developed for a nominal 500-MW integrated coal gasification, combined-cycle power plant. The British Gas/Lurgi slagging, fixed-bed gasifier was employed to produce a clean fuel gas from coal. The clean fuel gas was fired in near-term, advanced technology combustion gas turbines operating at combustor temperatures of 2200°F. Gas turbine exhausts were used to produce steam that was employed in a superheat/reheat main steam turbine generator to produce additional power. Duct burners and external combustors were investigated for the purpose of firing any fuel gas available in excess of that consumed by the gas turbines. The results of the study indicate that the power plant has the potential to provide base-load electricity at a cost that is 10% to 15% lower than the cost of electricity produced by a conventional coal-steam plant. In addition, the plant has the capability for producing very low-cost peak and intermediate load electricity. Harmful emissions from the plant would be considerably reduced in quantity relative to conventional coal-fired plants. 24 figures, 43 tables.

22294 (FRNC-TH—1715) Petrography of coke optical textures and its applications. Garza Gomez, A. (Orleans Univ., 45 (France)). 15 Dec 1982. 151p. (In French). NTIS (US Sales Only), PC A08. File Number DE85751007.

A petrographical characterization of coal samples used is first presented. The coking properties of such samples are then determined. A coke petrography including the analysis of the major factors affecting the formation of the anisotropic structures during the carbonization is developed. This petrography is applied to cokes produced on a semi-industrial scale in the Marienau Experimental Station. A kinetic model of the coke gasification reaction is finally studied.

22295 (IEA/ICEAS/E—3/2) Cost of liquid fuels from coal. Part II. Fischer-Tropsch liquids. Holmes, J.M.; Hemming, D.F.; Teper, M. (International Energy Agency Coal Research, London (UK)). Nov 1984. 95p. NTIS (US Sales Only), PC A05/MF A01. File Number TI85901170.

The production of Fischer-Tropsch liquids from coal requires the gasification of the coal to give a raw gas which must be purified (to remove sulfur compounds and most of the carbon dioxide), adjusted to the correct chemical composition and then passed over a suitable catalyst. This study has been confined to an evaluation of the production of transport fuels using dry-ash Lurgi and Texaco gasifiers. Two different process configurations have been examined; co-production of SNG, and reforming of the methane produced to synthesis gas and conversion to additional liquid fuels. Two types of reactors have been evaluated: entrained-flow Synthol (as used at Sasol) and liquid-phase (Koelbel) synthesis. We have considered gasification of a high-sulfur bituminous coal, namely Illinois No. 6; and a low-sulfur sub-bituminous coal, namely Wandoan (from Queensland, Australia). We have assumed plants with coal feeds of 20,600 tons of maf coal per stream day to the gasifiers, producing typically about 6000 t/d (60,000 BPSD) of gasoline, diesel and LPG. We estimated product yields from detailed material balances of all the process options considered and developed plant capital costs from published data; we then calculated product costs in $/GJ using a discounted cash-flow analysis. The analysis was carried out in constant mid-1981 dollars for a range of coal prices and DCF rates-of-return for a no-tax and no-depreciation case, and for a 48% tax with 10% investment tax credit and accelerated depreciation case. 89 references, 7 figures, 12 tables.

22296 (NRCC—20600) Report on a study on the biogasification of peat. (National Research Council of Canada, Halifax, Nova Scotia). 1982. 72p. National Research Council of Canada, Halifax, Nova Scotia.

This paper presents a review of the literature on biogasification of peat, a discussion of current U.S. research, description and economic analyses of the two promising processes and an economic comparison with certain other peat utilization schemes. Conclusions derived from this study and recommendations for further work on biogasification are included.

22297 (PB—85-155984/XAB) Importance of active sites for char gasification in oxygen (air) and carbon dioxide. Annual report, October 1983-September 1984. Jenkins, R.G.; Piotrowski, A. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Dec 1984. 41p. NTIS, PC A03/MF A01.

See also PB84-148105.

Nonisothermal gasification reactivities in air (5 K/min) and the isothermal reactivities in carbon dioxide (973 and 1073 K) of a Montana lignite and chars, prepared by slow and rapid pyrolysis of the raw and suitably pretreated lignite, were measured by thermogravimetric analysis. The coal pretreatment involved demineralization, ion exchange with ammonium acetate, and subsequent ion exchange with calcium acetate. Reactivity data show the marked influence of the presence of calcium species on reactivity in both air and carbon dioxide. However, there appears to be a saturation effect. That is, after a certain quantity of calcium ion is added (about 0.49 mmole/g) further addition does not have an appreciable influence on the measured gasification reactivity. In an attempt to measure the concentration of carbon-active sites, oxygen chemisorption capacities of several prepared chars were determined at 375 K and 0.1 MPa air. It is noted that the active area does reflect the order of reactivity in both air and carbon dioxide. Highly reactive chars chemisorb large quantities of oxygen at the conditions used, indicating high activity.

22298 (UCRL—91927-Rev.1) Results of mathematical modeling of oil shale retorting in an aboveground, external-combustion, moving-bed retort. Revision 1. Braun, R.L.; Lewis, A.E. (Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-7405-ENG-48. 13p. (CONF-8504101—1-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009448.

From 18. oil shale symposium; Grand Junction, CO, USA (22 Apr 1985).

Our one-dimensional mathematical model for simulating the chemical reactions and physical processes involved in oil shale retorting was applied to the indirect mode of operating an aboveground retort in which externally heated recycle gas provides the heat required for the retorting process. Countercurrent to the hot gas flow, a moving bed of shale is pushed upward through an expanding conical reactor, as in the Union B retort. The model was applied to a hypothetical set of commercial-scale conditions in order to identify key operating or design parameters. Variations in recycle-gas temperature and flow rate, shale flow rate, shale grade, water content, particle size distribution, bed porosity, uniformity of bed porosity, and retort dimensions were studied. The results of these calculations help identify the relative importance of the differ-

ent process parameters in terms of oil yield, pressure drop, exit temperature of gas and shale, fuel consumed in heating the recycle gas, compressor power, condenser cooling load, and reactor size. 11 references, 9 figures, 4 tables.

22299 **Retrograde reactions in SRC-I liquefaction.** Burke, F.P.; Jones, D.C.; Winschel, R.A. (Coal Research Division, Conoco Inc., Library, PA). *Fuel;* 64: No. 1, 15-21(Jan 1985).

Operating the vapour-liquid separators in the solvent refined coal (SRC-I) process at or near the reactor temperature is desirable to retain the heat in the liquid product stream which is necessary for subsequent distillation. However, adverse changes in the product composition resulting from high temperature operation (i.e., 'coking') would obviate this advantage. A study of these potential retrograde reactions using a 4.5 kg h^{-1} bench-scale coal liquefaction unit is reported. At high pressure, separator temperatures up to 722 K and residence times in the pressure let-down system of 15 to 30 min, retrograde reactions occur as conversion of a few per cent of the product SRC to insoluble organic matter. If sufficient agitation is present in the separators these retrograde reactions would have little effect on product yields or unit operability. Coking, manifested as the accumulation of significant deposits of anisotropic carbon in the separator vessels, occurs only with the extended time-at-temperature that the solids can experience in a poorly agitated vessel.

22300 **H_2S optimization for lignite liquefaction.** Willson, W.G.; Hei, R.; Riskedahl, D.; Stenberg, V.I. (University of North Dakota Energy Research Center, Grand Forks, ND). *Fuel;* 64: No. 1, 128-130(Jan 1985).

Two lignite samples, Beulah No. 3 and Big Brown No. 1, were liquefied at 420°C using H_2 and synthesis gas to determine the optimum beneficial amount of H_2S in the batch autoclave reactor. Under the conditions employed, 50–100 psi partial pressure of H_2S, nominally 4–10 wt% of daf lignite, was optimum for both samples. Synthesis gas outperformed H_2 with and without H_2S for the liquefaction of the two coals.

22301 **Organic titanium in coal and the deposition of titanium on direct liquefaction catalysts. An alternative view.** Robbat, A.; Finseth, D.H.; Lett, R.G. (Department of Chemistry, Tufts University, Medford, MA). *Fuel;* 63: No. 12, 1710-1715(Dec 1984).

Evidence for the presence of soluble organic titanium species in coals and coal-derived materials was sought by the application of dialysis procedures. Dialysates prepared from a heavy direct liquefaction product, an SRC-I, and extracts of the corresponding feed coals contained <2ppm titanium. A series of model organic titanium compounds traversed the dialysis membrane at a rate similar to that of the direct liquefaction product. The membrane was also permeable to porphyrinic metals of the type existing in petroleum crudes. These results suggest that mechanisms for the deposition of titanium on coal liquefaction catalysts that do not involve the postulation of significant concentrations of organic titanium species should be considered. A mechanism based upon the deposition of inorganic titanium in microparticulate or colloidal form is consistent with recent findings on the distribution of inorganic titanium in coals, the behavior of titanium under liquefaction conditions, and the observed deposition on spent catalyst.

22302 **Coal liquefaction using ore catalysts.** Mathur, V.K.; Fakoukakis, E.P.; Ruether, J.A. (Department of Chemical Engineering, University of New Hampshire, Durham, NH). *Fuel;* 63: No. 12, 1700-1705(Dec 1984).

Ores and ore concentrates containing minerals of Co, Mo, Ni, Fe, and other potentially active metals have been investigated as slurry catalysts for liquefaction of Blacksville mine, Pittsburgh seam, bituminous coal. The tests were conducted batchwise in a stirred autoclave for 30 min at 425°C and 13.79 MPa (2000 psig) hydrogen pressure according to a two-cycle scheme. In the first cycle, the reaction charge consisted of ground coal, catalyst, hydrogen, and SRC-II heavy distillate. The product of the first cycle was hot-filtered, and the liquid product served as a vehicle for the second cycle, which was otherwise run identically to the first. Reaction products from each cycle were analysed to determine conversion of coal, yield of liquids, liquid product viscosity, and group type (preasphaltene, asphaltene, and oil). Mixtures of ores containing iron pyrites and minerals containing other catalytically active transition metals were compared to pyrites along and to a pulverized supported Co-Mo-alumina catalyst. An ore catalyst containing both Fe and Ni was superior to another that contained an equivalent mass of iron alone. The best ore catalysts tested, in terms of high liquid yields and low product viscosities, were mixtures of pyrites and molybdenum- and cobalt-containing ores. The latter yielded results that approached those obtained with an equivalent mass of cobalt and molybdenum on an alumina support.

22303 **(BG-Trans—6349) Non-isothermal reaction kinetics of coal pyrolysis. Part III. The reaction pattern at rapid heating-up rates.** Koch, A.; Juentgen, H.; Peters, W. Translated from *Brennstoff-Chemie ;* 50: No. 12, 369-373(1969). 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900922. DE85900922

This paper reports on results from determination of the splitting off of gas from hard coals of different degrees of carbonisation at heating-up rates of around 10^4 degrees per minute and particle sizes between 60 μ and 0.6 mm using a time of flight mass spectrometer. The splitting off of the higher hydrocarbons can be interpreted by a reaction complex with an apparent energy of activation of between 27.3 and 36 kcal/mol an a true energy of activation of between 58.7 and 63.6 kcal/mol. Calculations based on the results obtained indicate the existence of a boundary or limiting curve dependent upon the heating-up rate and the particle diameter above which the pyrolysis of coal passes from a 1st order volume reaction into a 0 order reaction governed by heat transfer which is a function of the particle diameter. 12 references, 9 figures, 2 tables.

0105 By-products

22304 **Hydrocracking of diphenylmethane Roles of H_2S, pyrrhotite and pyrite.** Ogawa, T.; Montano, P.A.; Stenberg, V.I. (Department of Chemistry, University of North Dakota, Grand Forks, ND). *Fuel;* 63: No. 12, 1660-1663(Dec 1984).

This study presents the role of H_2S other than as H-transfer catalyst in the hydrocracking of diphenylmethane with H_2-H_2S-pyrrhotite. The results indicate that the partial pressure of H_2S controls the conversion of pyrrhotite to FeS and FeS_2, which in turn is closely related to the promotional activity of pyrrhotite on the diphenylmethane conversion. Under higher H_2S overpressures, pyrite bands appear in the Mossbauer spectra providing proof of the reversibility of pyrite decomposition under liquefaction conditions. With lower H_2S pressures, low activity troilite forms from the pyrrhotite. An enhanced activity was observed for a partial pressure of H_2S, sufficient for the maintenance of a high iron deficient surface on the pyrrhotite particles. When the partial pressure was increased too much, the formation of FeS_2 was observed with a slight decrease in activity. FeS did not show as great an activity as the nonstoichiometric pyrrohite.

0106 Properties

REFER ALSO TO CITATION(S) 01060022286, 22321, 22337, 22341

22305 **(BMFT-FB-T—84-293) Caking and coking power of bituminous coals under high pressures - pressure-dependent Roga index.** Beyer, H.D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1984. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751118.

After investigation of the pressure-dependency of the swelling index and of the dilatation behaviour under a former research project (BMFT-FB-T82-055), the objective of the present research work has been to clarify the pressure-dependency of the caking power of bituminous coals characterized by the Roga index RI (ISO 335) in the range up to 100 bar. Contrary to the swelling index, the Roga index turns out to be largely pressure-independent. For none of the coals subjected to pressurized measurements did classification according to their caking power have to be changed. Therefore it is sufficient even for pressurized technical processes to classify the coals according to their caking power based on RI

measurements carried out under atmospheric pressure. To make allowance, however, for the consequences of the operating conditions of specific technical processes on the behaviour of the coal, it may be advisable to determine modified RI values too. In this context the influence of a number of parameters on the RI values were investigated.

22306 **(CONF-850211—8) Evaluation of structural properties of coal seams.** Szwilski, A.B. (Kentucky Univ., Lexington (USA)). 1985. Contract AS05-81ER10840. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009275.

From 114. AIME annual meeting (includes Society of Mining Engineers); New York, NY, USA (24 Feb 1985).

A correlation between the rank, ash content and coal seam discontinuities and coal strength/stiffness is discussed. Rebound hammers were used to evaluate the strength properties of two coal seams. The coefficient of variability of the rebound tests are compared with those of laboratory compressive strength tests by other investigators. 8 references, 6 figures, 6 tables.

22307 **(DOE/FE/60181—103) Effects of sulfur retention in ash on mass balance calculations.** Knudson, C.L.; Holm, P.L. (North Dakota Univ., Grand Forks (USA). Energy Research Center; Minnesota Univ., Crookston (USA). Dept. of Chemistry). Mar 1985. Contract FC21-83FE60181. 17p. (CONF-850357—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008504.

From Spring national meeting of AIChE; Houston, TX, USA (24 Mar 1985).

Comprehensive analyses of 14 coals and coal ash indicates that coal sulfur is selectively retained in the ash during ASTM ash determinations as sulfate depending on the atomic calcium-to-sulfur (Ca:S) ratio. The 14 coals have been extensively used in coal liquefaction research. The coals range in ash content from 3 to 46 wt %, in calcium (Ca) content from 0.3 to 1.8 wt %, and in total sulfur content from 0.52 to 4.22 wt % of mf coal. It was found that both x-ray fluorescence and Leco sulfur techniques gave comparable sulfur contents of ash. Atomic Ca:S ratios from 0.21 to 4.32. Five coals had atomic Ca:S ratios from 0.2 to 0.8 which correlated with their sulfur retentions from 5% to 80% with a correlation coefficient of 0.997. Four coals with Ca:S ratios between 0.8 and 1.5 gave 83% to 89% sulfur retention, while three low-sulfur coals (less than 0.52 wt % mf) and ratios over 2 resulted in 100% retention. A low-Ca bituminous coal resulted in only 5% sulfur retention in ash, while a high-Ca lignitic coal resulted in 74% sulfur retention in ash. The retained sulfur can be partially organic sulfur, since the amount retained may be more than is originally present as sulfate and pyritic sulfur. The effects of sulfur retention in ash on the calculation of the maf coal and the oxygen content of the coal and on liquefaction ash balances is discussed. The results indicate that mass balance calculations which force ash-in to equal ash-out can lead to the introduction of error. 4 references, 11 tables.

22308 **(DOE/PC/50809—T9) [Determination of the surface reactivity of coal powders]. Ninth quarterly report, September 1-November 30, 1984.** Fowkes, F.M. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 18 Mar 1985. Contract FG22-82PC50809. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008824.

Three surface chemical techniques for measuring the acidic and basic sites on the surface of powdered coal are described. These are flow microcalorimetry, electrophoresis and use of infrared spectral shifts. In this work all of the measurements have been made on four samples of coal from Pennsylvania State University coal bank. Two samples were bituminous and two were anthracites. The surface areas of these coals after micro-milling and sieving through a 230 mesh screen were determined by BET analysis of nitrogen absorption to be 1.8 to 7.7 square meters per gram.

22309 **(DOE/PC/60785—6) Organic oxygen characterization of coal and coal liquids. Quarterly progress report, November 1984-January 1985.** Ehmann, W.D.; Hamrin, C.E.; Koppenaal, D.W. (Kentucky Univ., Lexington (USA)). Feb 1985. Contract FG22-83PC60785. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85007480.

Organically bound oxygen is one of the most abundant elements in coal, yet the amount and quality of data covering its abundance, mode of occurrence and processing behavior are relatively lean. The rectification of this problem will require the development of appropriate methods of oxygen determination which have been lacking in the past. The stature of coal science today demands a technique for organic oxygen determination other than the outdated and error-prone oxygen-by-difference calculation. This investigation addresses this need and intends to develop methods suitable not only for total organic oxygen determination, but also for determination of oxygen functionality. The methods and techniques developed will then be applied to practical needs in characterizing the oxygen geochemistry of coal and the evaluation of coal drying on liquefaction behavior. 40 references, 9 figures, 6 tables.

22310 **(DOE/PC/70776—T2) Characterization of coal surfaces. Technical progress report, November 21, 1984-February 20, 1985.** Fuerstenau, D.W. (California Univ., Berkeley (USA). Coll. of Engineering). Mar 1985. Contract FG22-84PC70776. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008502.

The broad objective of this research program is to conduct a systematic investigation of the surface properties of coal and to relate them to coal utilization. Initial work is involved with quantification of oxygen functional groups on the surface of coal. Specifically, this report summarizes proximate and ultimate analysis of various available coals, as well as a partial review of oxygen functional group analysis techniques. Results using these analysis techniques, specifically the potentiometric titration of carboxyl and phenolic oxygen functional groups, are presented in conjunction with a new approach to assess coal wettability. This approach uses a film flotation cell developed for assessing coal producing lyophobicity-lyophilicity. Results of coal surface characterization using this technique are available for graphite, as well as for several Western and Eastern bituminous coals. 15 references, 9 figures, 2 tables.

22311 **(DOE/PC/70795—T2) Macromolecular chemistry of coalification. Quarterly report, November 1, 1984-January 31, 1985.** Larsen, J.W.; Kovac, J.; Shawver, S.E. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry; Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 15 Feb 1985. Contract FG22-84PC70795. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008254.

Coal contains hydrogen bond crosslinks in addition to ionic cross-links. The bulk of the work performed during the previous quarter was directed at the investigation of ionic crosslinks in low rank coals. The next step in the investigation of the macromolecular nature of coals focuses on the presence of hydrogen bond crosslinks in low rank coals. Again our basic approach is to compare the swelling ratios of native, untreated coal with coals derivatized to remove hydrogen bond crosslinks. The two methods of derivatization employed to remove hydrogen bond crosslinks are acetylation and methylation. Results of the experiment show that low rank coals may be derivatized to disrupt the hydrogen bond network resulting in an increase in swellability of the coal. Solvent whose solubility parameters are greater than 11(cal/cm^3/sup 1/2/ must be employed before the hydrogen bonds in the coal can be treated quantitatively using regular solution theory. 3 references, 2 figures, 3 tables.

22312 **(DOE/PC/70799—T1) Identification of nonvolatile coal derived products via chromatography coupled with on-line FTIR detection. Quarterly progress report, September 1-November 30, 1984.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Mar 1985. Contract FG22-84PC70799. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85007878.

This proposal builds upon our efforts during the last three years regarding the interfacing of Fourier transform infrared (FTIR) spectrometry with size exclusion and normal phase chromatography for the analysis of coal-derived products. Four objectives are proposed as follows: (1) optimize the high performance liquid chromatography (HPLC)-FTIR interface in terms of detectability, identifiability and chromatography; (2) extend the HPLC-FTIR approach to reversed phase chromatography wherein more efficient separations are possible for heteroatom species; (3) determine the feasibility of interfacing supercritical fluid chromatography with

FTIR for the analysis of coal derived products; and (4) employ hyphenated methods to ascertain on a molecular level the changes that occur in a nonvolatile coal derived product when various liquefaction parameters are varied. In summary, we have demonstrated for the first time a practical method for flow cell detection of reversed-phase HPLC eluents using the Fourier Transform Infrared spectrometer. No attempt has been made as yet to optimize the extractor/separator portion of this apparatus. In spite of this, readily identifiable, high signal-to-noise, on-line spectra are obtained with less than 300 μg of injected sample. Carbon tetrachloride has been demonstrated to possess all of the necessary characteristics in order for it to be employed as an infrared-transparent, flowing-extraction solvent. Thorough investigation of the RP-HPLC-FTIR method is currently underway. 16 references, 10 figures.

22313 **(DOE/PC/70799—T2) Identification of nonvolatile coal derived products via chromatography coupled with on-line FTIR detection. Quarterly progress report, December 1, 1984-February 28, 1985.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Mar 1985. Contract FG22-84PC70799. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008490.

This proposal builds upon our efforts during the last three years regarding the interfacing of Fourier transform infrared spectrometry with size exclusion and normal phase chromatography for the analysis of coal-derived products. Four objectives are proposed: (1) optimize the HPLC-FTIR interface in terms of detectability, identifiability and chromatography, (2) extend the HPLC-FTIR approach to reversed phase chromatography wherein more efficient separations are possible for heteroatom species, (3) determine the feasibility of interfacing supercritical fluid chromatography (SFC) with FTIR for the analysis of coal-derived products, and (4) employ hyphenated methods to ascertain on a molecular level the changes that occur in a nonvolatile coal derived product when various liquefaction parameters are varied. In summary, the lightpipe flow cell described herein has been demonstrated (at considerably higher pressures than previously reported) to be an improved interface between the SFC and FTIR. Used in conjunction with beam condensing optics, this flow cell yields high signal-to-noise spectra from an otherwise standard, commercially-available SFC instrument. The high infrared throughput, which can be directly attributed to the polished gold insert of the flow cell and the associated beam condensing optics, is perhaps the most important feature in obtaining the quality spectra shown. Continuing investigations into packed-column SFC-FTIR with the lightpipe interface and other supercritical mobile phases will be published subsequently. 13 references, 9 figures, 3 tables.

22314 **(FRNC-TH—1726) Behaviour of coal mineral matter during mechanical and thermal treatment.** Martinez Ortegon, L. (Orleans Univ., 45 (France)). Dec 1982. 130p. (In French). NTIS (US Sales Only), PC A07. File Number DE85751002.

This thesis deals with the study conducted on high mineral content coals of the behavior and transformation of this mineral matter as a function of changes parameters in the following treatments: mechanical preparation, combustion, pyrolysis and gasification.

22315 **(PB—85-149839/XAB) Photoacoustic microscopy of coal macerals. Final report, January 1982-August 1984.** Johnson, K.W.; Telschow, K.L.; Crelling, J.C. (Southern Illinois Univ., Carbondale (USA)). Sep 1984. 59p. NTIS, PC A04/MF A01.

See also PB84-179183.

The overall objective of the project was to develop photoacoustic microscopy as a new, in situ technique for delineating the thermal properties of coal macerals. This petrographic information is expected to play a role in the characterization of coal for any process where the properties of the coal determine the behavior of the process. To characterize coal properly, both its chemical composition and its thermal properties must be known. Photoacoustic microscopy offers a useful technique for probing the thermal-conductance and thermal-elastic properties of coal macerals. Coupled with the traditional reflectance measurements, which yield information about the optical properties of macerals, photoacoustic microscopy can be used to produce a more comprehensive classification of the properties of macerals. The major result achieved has been the development of a photoacoustic/reflectance microscope capable of obtaining thermal and optical data from the same coal macerals. The data on Appalachian-basin coals shows that their thermal properties vary considerably with rank, from Hi-Vol C bituminous to anthracite. These changes in thermal properties with rank have been explained using known properties of coal. In addition, there are significant differences between the thermal properties of vitrinite and pseudovitrinite macerals. The differences are especially prominent for low rank coals, such as Hi-Vol C, and gradually disappear in the higher rank coals beginning with semi-anthracite.

22316 **(PB—85-154722/XAB) Petrographic and fluorescence spectral properties of liptinite and vitrinite coal macerals. Final report, January 1982-May 1984.** Crelling, J.C. (Southern Illinois Univ., Carbondale (USA). Dept. of Geology). Jun 1984. 146p. NTIS, PC A07/MF A01.

See also PB84-167121.

The purpose of this study is to gain a better understanding of the properties of various coal macerals. Because it is both expensive and very difficult to separate the various macerals from coal, the macerals were studied in situ by quantitative fluorescence microscopy. This method has only recently been applied to the study of coal and has already lead to the discovery of new macerals, and a better understanding of coal rank and the coalification process. The results of this study showed that many fluorescent macerals are undercounted in normal white-light analysis and that additional structures and textures are often visible in fluorescence analysis. Fluorescence spectral analysis of various samples of the Herrin (No. 6) and Springfield-Harrisburg (No. 5) seam from Illinois and the Hartshorne seam from Oklahoma can quantitatively distinguish various maceral types and two or more varieties of each type. For example, in all of the seams examined, two varieties of the maceral, fluorinite, were characterized. To avoid nomenclature problems caused by the abundance of new maceral varieties, the concept of spectral type was developed. In samples of different rank from each of the three seams the fluorescence properties of fluorinite, sporinite, and cutinite show a systematic change with an increase in coal rank. In addition, secondary macerals were also identified - semi-fusinite and vitrinite. These macerals were specific to the host maceral and also showed a change in spectral properties with rank.

22317 **(PB—85-165900/XAB) Methods and procedures used at the National Bureau of Standards to certify sulfur in coal SRM's (Standard Reference Materials) for sulfur content, calorific value, ash content. Final report.** Gills, T.E. (National Bureau of Standards, Washington, DC (USA). Office of Standards Reference Materials). Dec 1984. 55p. (NBS/SP—260/94). NTIS, PC A04/MF A01.

Also available from Supt. of Docs as SN003-003-02629-8. Library of Congress catalog card No. 84-601148.

This special publication consists of a collection of analytical methods used at NBS for the determination of total sulfur, calorific value, and ash content in four different coals, SRM's 2682, 2683, 2684, and 2685, with nominal sulfur contents of 0.5, 2.0, 3.0, and 4.5 percent, respectively. Also, included are descriptions of methods and procedures used for providing noncertified values for approximately 30 elements including carbon, hydrogen, and nitrogen. These procedures were selected and often specifically developed, by the scientific staff members of NBS, to provide measurements with the best obtainable accuracy and precision. The materials for these SRM's were obtained and processed by Valley Forge Laboratories under a grant from the National Bureau of Standards. Material preparation of the four coal SRM's is described in NBS Special Publication 260-84, Sampling, Materials Handling, Processing, and Packaging of Standard Reference Coal Materials.

22318 **Characterization of extracts of coals and coal-derived products by liquid chromatography using optical activity detection.** Bobbitt, D.R.; Aida, T.; Chen, Y.Y.; Reitsma, B.H.; Rougvie, A.; Smith, B.F.; Squires, T.G.; Venier, C.G.; Yeung, E.S. (Ames Laboratory and Department of Chemistry, Iowa State University, Ames, IA). *Fuel;* **64**: No. 1, 114-118(Jan 1985).

Extracts from various coals and coal-derived products were studied using liquid chromatography with optical activity detection. The chromatograms show that there are substantial numbers of optically active components in these samples. Since both dextrorotatory and laevorotatory components are present, some mutual cancellation would result if only the bulk optical rotation were measured. The chromatograms are generally rich in structure and contain distinct features which may be good fingerprints for establishing the origins of the coals and monitoring coal processing.

0108 Waste Management

REFER ALSO TO CITATION(S) 01080022907, 23006

22319 (DOE/FE/60181—115) Additive enhancement of pressure-hydrated lime for control of SO_2/NO/sub x/ emissions. Bobman, M.H.; Weber, G.F.; Keener, T.C. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Mar 1985. Contract FC21-83FE60181. 24p. (CONF-850357—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008634.

From Spring national meeting of AIChE; Houston, TX, USA (24 Mar 1985).

Control of SO_2/NO/sub x/ emissions from low-rank coal combustion is investigated. This paper presents results from bench- and pilot-scal studies using pressure-hydrated lime and doped pressure-hydrated lime for the removal of SO_2/NO/sub x/. These results indicate that greater utilization of sorbent may be achieved through pressure-hydration. Activation energies, reaction orders, and possible rate-limiting mechanisms for the sorbent-SO_2 reactions are also presented. The reaction of SO_2 with three sorbents formed by pressure hydration of quicklime was studied using thermogravimetric analysis and pilot-scale injection into a boiler. A semi-empirical pore-plugging model was used to describe the sulfation of dehydroxylated sorbents with good correlation of predicted and measured values of conversion. Activation energies of 26.8 to 49.0 KJ/mole were observed, the latter for a sorbent doped with sodium. Pilot-scale combustion were conducted firing natural gas. Injection temperature and baghouse temperature were nominally 1270°K and 360° to 380°K, respectively. Sorbent utilization values exceeding 70% at an alkali/SO_2 mole ratio of 1.0 have been observed. Simultaneous NO/sub x/ reduction of up to 20% has been observed. 14 references, 18 figures, 4 tables.

22320 (DOE/LC/10934—1697) Methods of chemical analysis for ionic constituents in synfuel wastewaters. Final report. Wallace, J.R.; Alden, L. (Denver Research Inst., CO (USA)). 24 Sep 1984. Contract AS20-82LC10934. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003285.

The orginal thrust of this effort was towards improving ion chromatographic methods to detect all major ions. This technique was developed for the determination of chloride, nitrite, sulfite, phosphate, sulfate, nitrate, thiosulfate, and thiocyanate in a single run. A qualitative indication of total organic acids is also obtained. Sodium, ammoniacal-N, and K were determined separately by ion chromatography. Because the chloride peak occurred in a crowded portion of the ion chromatogram, an independent method was developed for chloride involving a digestion and titration. Measurements for pH and electrical conductivity were then made in order to check the accuracy of these individual measurements. However, it soon became clear that modified procedures for these measurements had to be developed in order to compensate for the high ionic strength of the synfuel samples. A computer program was developed to check the accuracy and completeness of the analyses by calculating ion balances, electrical conductivity, and total sulfur based on the individual determinations. Application of this program to a set of synfuel wastewaters indicated an acceptable agreement for most samples. However, it also became apparent that for some waters a major category of negative ions was missing, and for other samples the individual sulfur components did not account for the total sulfur found. For this reason additional efforts were directed towards determining the missing components. A gas chromatographic procedure involving a bonded-phase, carbowax capillary column was developed for the light organic acids. Efforts to develop a practical method for polysulfides, which were suspected as the missing sulfur component, were largely unsuccessful. 33 references, 14 figures, 12 tables.

22321 (DOE/PC/40783—T17) Instrumental methods of analysis of sulfur compounds in synfuel process streams. Final technical report, September 30, 1981-September 29, 1984. Jordan, J.; Talbott, J.; Yakupkovic, J. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Dec 1984. Contract FG22-81PC40783. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008166.

The general objective was to develop new instrumental methods of analysis for the determination of sulfur moieties and speciation of sulfur contaminants in representative samples of synfuel process streams. Accomplishments include novel approaches for the determination of sulfidic and polysulfidic sulfur by polarography and thermometric enthalpy titrations and of polythionates by differential pulse voltammetry. Diverse samples were analyzed including H-Coal sour water specimens, gasifier condensates, SRC effluents, DCD liquefaction samples, effluents from different stages in the Lummus liquefaction process wastewaters subjected to PETC cleanup and stripping treatments. The samples originated from a wide variety of locations ranging from Washington, Oregon and California to New York, Delaware and the Carolinas. A Manual of Recommended Voltammetric and Enthalpimetric Methods is included in the final report. A systematic and critical comparison of results obtained from the analysis of sulfur moieties in coal conversion process stream effluents has yielded illuminating corelations between the prevailing oxidation states of sulfur and pH, redox potential and oxidative stripping treatments. On the other hand, remarkable similarities were observed between liquefaction and gasification process streams: it was apparent that total sulfur contaminant levels in coal conversion process stream wastewater samples were primarily determined by the abundance of sulfur in the coal used as starting material, rather than by the nature of the conversion process (liquefaction or gasification). 8 references, 4 figures.

22322 (EPRI-CS—3923) Assessment of ash-sluice-system operating problems. Final report. Owen, M.L.; Jones, A.F. (Radian Corp., Austin, TX (USA)). Mar 1985. 327p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $26.50. File Number TI85920579.

This report presents the results of a utility survey designed to determine the magnitude, geographical distribution, and economic penalties associated with water quality related operating problems in coal-fired power plants recycling ash sluice water. Utilities which recycle ash sluice water were identified from existing literature and data bases. The following information was requested from these utilities in a survey: (1) reasons for water recycle, (2) type and magnitude of operating problems due to water quality, (3) costs resulting from the operating problems, (4) types, costs, and savings of corrective actions, and (5) costs of ash sluice operating problems relative to the costs of operating problems incurred by other major plant water systems. Survey responses indicated that recycling ash sluice water is becoming more predominant due to environmental regulations and decreasing water availability. Decreased water quality resulting from water recycle has caused ash sluice system operating problems in all regions of the US. The problems occur mainly in the pipes, valves, and pumps, with scaling being the most prevalent problem. Ash sluice system operating problems were perceived by the utilities to be expensive relative to the operating problem costs incurred by other major plant water systems. 4 references, 4 figures, 12 tables.

22323 (PB—85-139426/XAB) Study of physical characteristics of freshly produced fly ash from the exhaust gases of coal-fired power stations. Thijs, M. (Centre de Recherches Routieres, Brussels (Belgium)). [1984]. 145p. (In French). (CR—21/84). NTIS, PC E08/MF E08.

The physical and geotechnical characteristics of freshly produced fly-ash collected using dry methods from the exhaust gases of, for the most part, coal-fired power stations, were studied in the laboratory and on a pre-experimental site with a view to their use as a road embankment material. When subjected to certain conditions governing state, saturation, and stress, fly-ash used in embankment can undergo liquefaction, if it is has been inadequately com-

pacted (below a certain critical density). The critical density can be determined in the laboratory by means of prolonged and delicate triaxial tests, which is difficult to reconcile with the tempo of the works on this type of site.

22324 **(PB—85-156180/XAB) Evaluation of at-sea disposal of FGC (Flue Gas Cleaning) wastes. Volume 1. Biological testing and studies with untreated wastes. Final report on phase 3 May 1977-October 1983.** Cooper, C.B.; Lunt, R.R.; Bodek, I.; Santhanam, C.J. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Dec 1984. 166p. NTIS, PC A08/MF A01.

See also Volume 2, PB85-156198, and PB-269 270.

This two-part report is the third of a series on a continuing EPA research program on the feasibility of disposing of Flue Gas Cleaning (FGC) wastes in the ocean. Part 1 gives results of laboratory-scale chemical and biological experiments with untreated (unstabilized) FGC wastes designed to provide basic data on environmental impact potential. Part 2 gives results of further chemical and biological tests with a forced-oxidation (sulfate-rich) FGC waste and with stabilized FGC wastes. Results of tests performed to date and related assessment efforts indicate that the conventional (concentrated-dump) at-sea disposal of unstabilized FGC wastes with soil-like properties on the Continental Shelf appears to be environmentally undesirable, unless contradicted by further work. Test results also indicate that at-sea dispersed disposal of sulfate-rich (and, possibly, sulfite-rich) soil-like FGC wastes is sufficiently promising to merit further research. Likewise, results of this and other programs indicate that conventional or concentrated disposal of brick-like stabilized FGC wastes is also promising.

22325 **(USGS/WRI—83-4173) Trace metals in surface water and stream sediments of Healy and Lignite Creek Basins, Alaska.** Parks, B. (Geological Survey, Anchorage, AK (USA)). 1983. 31p. US Geological Survey, Box 25425, Federal Center, Denver, CO 80225. File Number TI85901271.

Coal has been strip-mined in the Healy and Lignite Creek basins of the Nenana coal field. Trace metals concentrations are low in Healy Creek, but are higher in the Lignite Creek basin. Concentrations of trace metals increase as Healy Creek and Sanderson Creek (in the Lignite basin) flow past mined areas, but effects of coal mining cannot be distinguished from those due to a change in lithology or coal outcrop burning. Metals are typically concentrated on the suspended sediment. The source of the trace metals on sediment and in the water is probably the fine-grained Tertiary rock of the coal-bearing group. Local coals do not contain high levels of trace metals. Concentrations of dissolved and suspended trace metals in water and total-recoverable trace metals in the bed material do not present an environmental hazard in the Healy and Lignite Creek basins at this time. Mining does not appear to have had any appreciable effect on the quality of ground water in the basins. 14 references, 8 tables.

22326 **Studies of sintering of coal ash relevant to pulverised coal utility boilers 2. Preliminary studies of compressive strengths of fly ash sinters.** Tangsathitkulchai, M.; Austin, L.G. (Fuel Science Section, Department of Materials Science and Engineering, The Pennsylvania State University, University Park, PA). *Fuel;* 64: No. 1, 86-92(Jan 1985).

The development of strength of pellets of fly ash with sintering temperature was investigated. Pellets heated below the shrinkage or electrical (Raask) sinter point did not develop strength over several hours. Hot crushing of pellets above the sinter point gave plastic deformation, presumably due to liquid on the particle surfaces. Cooling below the sinter point before crushing gave the same strength as crushing at room temperature, showing strength was due to solidification. Strength as a function of heat treatment temperature (1 h duration) above the sinter point went through a maximum, indicating that liquid is removed at higher temperature. SEM analysis of the cold pellets showed glassy sintering at conditions of maximum strength, and crystallization of mullite as strength decreased with higher heat treatment temperatures. Results suggest that iron silicate compositions increased the maximum sinter strength more than sodium silicate compositions. Water washing of fly ash reduced maximum strength. Addition of Na_2O or surface films of sodium carbonate to a synthetic mineral mixture reduced the sinter point and led to strength development at lower temperatures: however, too high additions reduced the maximum strength.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 01090022276, 22325, 22357, 22364, 23064, 23078, 23093, 23163

22327 **(DOE/PETC/TR—85/6) Analysis of toxicity of leachates from coal liquefaction wastewater treatment sludge.** Dahlberg, M.D.; Ruppel, T.C. (USDOE Pittsburgh Energy Technology Center, PA). Mar 1985. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009791.

The disposal requirements for wastewater treatment sludge from coal liquefaction plants will be determined by toxicity tests established by the Environmental Protection Agency (EPA) to enforce the Resource Conservation and Recovery Act (RCRA). Concentrations of eight elements in samples from a noncommercial plant were well below the standards used in the EP (extraction procedure) test of the EPA. Toxicity bioassays with Daphnia magna supported the results of the EP tests. Leachates generated according to the American Society for Testing and Materials extraction procedure (ASTM D-3987) were also tested. Concentrations of RCRA elements were frequently below the minimum detectable concentrations, and no differences in toxicity of the EP and ASTM extracts were evident. 17 references, 3 tables.

22328 **(NRCC—22858) Identification of the pollution potential of the harvesting and pre-utilization processing of peat as an energy commodity.** Washburn, O.V. (National Research Council of Canada, Halifax, Nova Scotia). 1983. 75p. National Research Council of Canada, Halifax, Nova Scotia.

The literature was reviewed to identify sources of environmental impacts resulting from the mining and pre-utilization of fuel peat in Canada and to identify possible methods to mitigate these impacts. Much of the information available from the literature applies to non-fuel uses of peat and is presented in a general manner because details are site specific. Dry mining of peat may result in increased levels of particulates and increased acidity. Particulate levels may be reduced through the use of settling ponds and through the design of drainage ditches so runoff will filter through peat before entering receiving waters. Increased acidity of drainage water may be reduced by treating wastewater in a manner similar to acid drainage from coal mines. Impacts of hydraulic mining of peat differ from those of dry mining techniques and are dependent on the method of dewatering. Wet carbonization and partial wet oxidation are methods proposed to break down the colloidal structure of peat to facilitate mechanical dewatering. The wastewater treatment techniques recommended are a combination of anaerobic and aerobic treatments which aim to lower BOD, COD and remove organics. Information on waste streams from wet carbonization and partial wet oxidation is based on laboratory studies and pilot tests rather than full scale production operations.

22329 **(PB—85-122687/XAB) Viability of seed produced on highly sodic coal-mine spoils. Forest Service research note.** Richardson, B.Z.; McDonough, W.T.; Farmer, E.E. (Forest Service, Ogden, UT (USA). Intermountain Forest and Range Experiment Station). Oct 1984. 7p. NTIS, PC A02/MF A01.

An adapted plant species must not only grow on a particular site, but also produce viable seeds capable of germination and establishment on the site. Ten species of rangeland grasses had been successfully used to revegetate sodic mine spoils at the Decker Coal Mine in southeastern Montana. However, the effect of the sodic spoils on seed viability, and hence the potential for regeneration, was unknown. Seeds produced by these plants were tested for viability and germination.

22330 **(USGS-OFR—83-205) Data supplement to: quality of coal mine drainage in Washington, 1975-77.** Fuste, L.A.; Packard, F.A.; Fretwell, M.O.; Garland, D.P. (Geological Survey, Tacoma, WA (USA)). 1983. 69p. US Geological Survey,, Box 25425, Federal Center, Denver, CO 80225. File Number TI85901270.

The US Geological Survey studied coal-mine drainage in western Washington to (1) characterize the water quality of drainage from abandoned mines in the 11 coal-bearing areas of the state; (2) examine the water-quality effects on a stream receiving drainage from an abandoned coal mine; (3) determine the baseline water-quality conditions at two prospective underground coal-mine areas; and (4) recommend procedures for monitoring stream quality in the baseline areas in the event that mining occurs. This report presents physical, chemical, and biological data collected during the study period from Gallop Creek (Whatcom County), Loretta Creek (Skagit County), and Wilkeson Creek (Pierce County) and from 100 abandoned coal mines in western Washington, and from a borehole hydraulic-mining test site. Biological information included taxonomic identifications and counts of benthic invertebrates and periphytic algae. 8 references, 21 tables, 10 maps.

0110 Reserves And Exploration

22331 **(PB—85-149128/XAB) Coal resources of the Southwestern District, Kentucky: Bell, Clay, Clinton, Estill, Jackson, Knox, Laurel, Lee, Madison, McCreary, Owsley, Pulaski, Rockcastle, Wayne, and Whitley counties.** Brant, R.A.; Smith, G.E. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). May 1983. 93p. (IMMR—83-080). NTIS, PC A05/MF A01.

Prepared in cooperation with Kentucky Geological Survey, Lexington. Sponsored by Kentucky Energy Cabinet, Lexington.

The Southwestern District contains an estimated 7.43 billion short tons of original coal resources. Remaining coal resources total an estimated 6.85 billion short tons as of January 1, 1981. The coal resources are tabulated by standard U. S. Geological Survey resource classes for 25 of the coal beds that occur in the district. Clay County contains an estimated 1.54 billion tons, or 21 percent of the district total, followed by Knox, which contains 1.38 billion tons, or 19 percent of the district total. Bell County contains an estimated 1.03 billion tons, or 14 percent, and Whitley County contains 975 million tons, or 13 percent of the district total. Remaining coal resources in the other 11 counties range from 70 thousand tons in Madison County to nearly 574 million tons in Owsley County.

0120 Mining

REFER ALSO TO CITATION(S) 01200022275, 22328, 22365, 22366, 22367, 22733, 23051

22332 **(DOE/EIA—0125(84/40)) Coal distribution, January-December 1984.** McNair, M.B. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Apr 1985. 181p. NTIS, PC A09/MF A01; 1 - GPO; GPO Dep. File Number DE85009890.

This Energy Information Administration (EIA) report continues the quarterly series on coal distribution started in 1957 by the Bureau of Mines. The publication provides volume data on coal distribution by coal-producing district, consumer use, and method of transportation necessary for EIA to fulfill its data collection functions as authorized by Sections 5 and 13 of the Federal Energy Administration Act of 1974 (P.L. 93-275) as amended. The report is widely distributed to Federal and State agencies, the coal industry, and the general public. All data for 1980-1984 in this report are final. Beginning with the first quarter of 1984, this report was redesigned as part of the continuing efforts of the Energy Information Administration (EIA) to publish accurate and timely energy information at minimal cost. In order to provide accessible coal distribution data to a variety of clients in formats that are useful to them, the following major changes have been made in the structure of data within this report: (1) The format for tables involving data presented by coal-producing district of origin is revised allowing these tables to be printed on significantly fewer pages. In particular, Tables 7 and 8 (formerly Table 9) were reduced from 59 to 27 pages. The grouping of coal-producing districts by five coal-producing areas (Tables 2 and 3 and Figures 1 and 2) was replaced with a grouping by three coal-producing regions (see the Glossary for a definition of these regions). In addition to the changes outlined above, beginning stocks were deleted in Table 1. The Office of Coal, Nuclear, Electric and Alternate Fuels gratefully acknowledges the cooperation of the respondents in supplying the details that made this report possible. 5 figures, 57 tables.

22333 **(DOE/PC/52274—T6) Mining Research and Development Program. Third quarterly report, September 25-December 25, 1982.** Dingerson, M.R. (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). [1983]. Contract FG22-82PC52274. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85005440.

The technical activities of Southern Illinois University at Carbondale related to the development of a Mining Research and Development Program at the Carbondale Mining Technology Center are described. Six technical project activities were operating: Hydraulic Fragmentation, Analysis of Economics and Productivity in Strip Mining, Integration of Man and Machine into Efficient Mining, Computer Models for Simulation in Coal Mining, Geotechnical Studies Related to Advanced Mining, and Dragline Simulator Training Systems. Special achievements this period include: The agreement between the theoretical and experimental results of several gas-release capillary models indicate that the refinements in these theoretical models have improved their predictive capabilities. A complete computerized mathematical model of a water jet in air has been completed, including both the core of the jet and the surrounding air droplet flows. New theoretical efficiency measures of price data were developed. These are duals of the quantity measures previously developed in the economics studies of strip mining of coal. A computer program was developed for use in collecting and recording physiological data from man and machine experiments. Finite element models and techniques for analyzing auger holes in a non-homogeneous rock mass subjected to in-situ stresses were studied. The first auger hole next to the mine opening is relatively the most unstable of the auger holes. Final arrangements are being made to use the operator course material in training a newly assembled dragline crew at the Center. Two appendices have been entered individually into EDB and ERA.

22334 (DOE/PC/52274—T6, pp 24-45) **Hydraulic intrusion by a traversing water jet. Appendix A.** Evers, J.L.; Eddingfield, D.L.; Man, W.S. [1983]. NTIS, PC A04/MF A01. File Number DE85005440.

In Mining Research and Development Program. Third quarterly report, September 25-December 25, 1982.

A theoretical model has been developed and experimentally verified that describes the flow of a fluid column, produced by a traversing water jet, into an air filled capillary tube. The study shows the potential for hydraulically exploiting certain internal spaces in minerals that can be modeled by a dead-end capillary tube of equivalent hydraulic radius. The effect of cavity size, jet traverse rate and impingement pressure on the pressure pulse produced in the trapped gas is analyzed. Pressure pulses that are orders of magnitude higher than the jet impact pressure have been predicted for flow spaces with relatively large diameters and short lengths. 11 references, 16 figures.

22335 (DOE/PC/52274—T6, pp 46-66) **Geotechnical study of bidirectional augering field tests. Appendix B.** Chugh, Y.P.; Caudle, R.D.; Agarwala, V.K. [1983]. NTIS, PC A04/MF A01. File Number DE85005440.

In Mining Research and Development Program. Third quarterly report, September 25-December 25, 1982.

During this quarter, finite element models and techniques for analyzing auger holes in the non-homogeneous rock mass subjected to in-situ stresses were investigated. The stability of two and three auger holes and rectangular mine opening in homogeneous rock mass was analyzed. Four foot diameter holes at 6-foot centers in the pillar and mine opening are stable in the homogeneous rock mass. The first auger hole next to the mine opening is relatively the most unstable auger hole. Additional and more detailed studies of

auger holes in an non-homogeneous layered medium are presently being conducted and the results will be presented in the next quarterly report. 12 references, 12 figures.

22336 **(NP—4901496) Longwall demonstration in western Canadian coals. Phase I. Mine planning and systems engineering. Volume 4. Appendices - longwall equipment.** (McIntyre Mines Ltd., Calgary, Alberta (Canada)). 14 Jan 1983. 268p. NTIS (US Sales Only), PC A12/MF A01. File Number DE84901496.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 01300022309, 22345

22337 **(BCRNL-L—1468) Evaluation of the effect of coal cleaning on fugitive elements. Phase IV. Identification of mineral forms in coal. Quarterly progress report No. 7, December 1, 1984-February 28, 1985.** Streeter, R.C. (Bituminous Coal Research, Inc., Monroeville, PA (USA). National Lab.). 8 Apr 1985. Contract AC22-83PC62690. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009173.

Determination of major mineral forms in the Otisca B and LICADO coal samples (low-temperature ashes) was completed. Analyses of the major elements (Si, Al, Fe, Ca, Mg, Na, K, Ti, P, S, and Mn) and eight trace elements (Be, Cd, Co, Cu, Pb, Ni, V, and Zn) in the high-temperature (750°C) ashes of the Otisca A, Otisca B, and LICADO coals were completed, and the results are reported herein. 1 figure, 4 tables.

22338 **(DOE/PC/70057—T1) Dilute, dense-phase and maximum solid-gas transport. First quarterly report.** Gidaspow, D.; Syamlal, M.; Seo, Y.; Luo, K.M. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). Nov 1984. Contract FG22-84PC70057. 28p. NTIS, PC A03/MF A01. File Number DE85002986.

The objective of this investigation is to develop an experimentally verified theory of gas-solid transport that will permit scale-up and design of many coal feeding and transport systems. Pneumatic transport was studied at the IGT pilot plant, and is discussed in detail in the experimental section. Unfortunately, IGT requested us to move the equipment since they need the space for other DOE projects. Plans have been made to install the set-up in the Unit Operations Laboratory of the Chemical Engineering Department. In view of the necessary move, improvements will be made in the feeding system for more precise modeling of the experiment. A parametric study of two dimensional flow in the pneumatic pipe has been completed, and is discussed in the modeling section of this report. 5 references, 17 figures, 2 tables.

22339 **(DOE/PC/70057—T2) Dilute, dense-phase and maximum solid-gas transport. Second quarterly report.** Gidaspow, D.; Syamlal, M.; Seo, Y.; Luo, K.M. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). Mar 1985. Contract FG22-84PC70057. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008867.

The objective of this investigation is to develop an experimentally verified theory of gas-solid transport that will permit scale-up and design of many coal feeding and transport systems. The prediction of maximum solid-gas transport is needed in many coal feeding systems. Several mathematical models were studied to determine such critical multiphase flow. It was found that dense-phase transport may be limited by a critical velocity equal to square root of G/rho/sub s/, where G is an Elastic modulus of the power and rho/sub s/ is its density. An experimental set-up for pneumatic transport was installed in the Chemical Engineering Department at IIT. It incorporates a number of improvements over the set-up operated previouly at IGT. A vertical pipe starts on the first floor where entrance region solids concentration will be measured with a movable γ-ray densitometer, and extends to the second floor where concentration and velocity profiles will be measured in the developed region. A pre-prediction of pressure, velocity and concentration profiles was made to anticipate the experimental information to be determined soon. 33 references, 6 figures.

22340 **(DOE/PC/70803—T2) Model for the flow of particulate matter with application to chutes. Quarterly technical report, December 1, 1984-February 28, 1985.** Jackson, R. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1985. Contract FG22-84PC70803. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008148.

Results from a more extensive analysis of a proposed constitutively based theory of granular flow are presented. A comparison of theoretical predictions and experimental measurements from shear cell experiments indicate that the theory accurately predicts the normal stresses generated in a shearing granular sample for a wide range of shear rates. The predicted shear stresses are generally greater than those which are experimentally measured, which may be the result of incorrect choices of physical parameters, or a misinterpretation of experimental observations - a subject which requires further investigation. 5 references.

22341 **(EPRI-CS—3808) Coal Cleaning Test Facility campaign report No. 1: Freeport Seam coal.** Parkinson, J.W.; Torak, E.R.; Bhowmick, A.K.; Cavalet, J.R. (Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA); Science Applications International Corp., Homer City, PA (USA)). Feb 1985. 168p. Research Reports Center, P.O. Box 50490, Pao Alto, CA 94303 $17.50. File Number TI85920545.

Campaign Report No. 1, issued by EPRI's Coal Cleaning Test Facility (CCTF), covers three test programs over a three-month period in late 1982 and early 1983. The first of these three programs, a Coal Cleanability Characterization of Pennsylvania Freeport Seam coal, determined raw-coal characteristics, sulfur and ash liberation potential and the change in characteristics produced by cleaning the coal to several quality levels using commercial-scale equipment. The CCTF tests showed that crushing this coal to 3/4-in. topsize liberated substantial amounts of pyritic sulfur that can be readily removed by physical coal cleaning. CCTF flowsheets tests demonstrated that cleaning reduced the raw-coal sulfur dioxide emission potential of 2.5 lb/MBtu to 1.2 lb/MBtu, yet recovered more than 90% of the raw-coal's heating value (Btu). This investigation, which is currently being used by two utilities in their emission control plans, represents one of the few complete assessments of the effectiveness of coal cleaning as a compliance method. In the second test program, six heavy-media cyclone performance tests were performed using three different cyclones. The test results show that mounting position affects cyclone performance. Higher feed flow rates in the near-horizontal position, require fewer cyclones to achieve a given capacity. The third program demonstrated the effectiveness and practicality of MAGNADISC magnetite recovery system for magnetite. These tests show that 60 to 80% of the lost magnetite can be recovered using MAGNADISC. An economic analysis performed for a 500-th coal-cleaning plant considering ranges of magnetite losses, magnetite prices and equipment life shows positive net present value in all cases, indicating a worthwhile investment. 40 figures, 37 tables.

22342 **(PB—85-149441/XAB) Coal injector for coarse slurry transport. Open file report, 1 July 1975-30 April 1983.** Burnett, M.; Rubin, L.S.; Harvey, A.; Roberge, J.C.; Cardenas, R.L. (Foster-Miller, Inc., Waltham, MA (USA)). Dec 1983. 263p. NTIS, PC A12/MF A01.

An inducer-type pump, capable of injecting dry coal into a hydraulic transport pipeline was developed and installed in a specially designed and fabricated slurry injector vehicle. The full-scale prototype injector system can deliver up to 11 ton/min of coal into an 8-in pipeline at pressures up to 95 lb/sq in. The helical inducer injector operates on centrifugal principles with flow passing axially through a helical-pitched conical rotor. Water is delivered to the pump through an annular slot at the atmospheric pressure coal inlet. The spinning rotor maintains an air-core vortex of water that pressurizes the discharge housing. A screw feeds coal through the open inlet into the vortex. The inner radius of the vortex contracts as pressure is increased, giving a limiting maximum pressure that is proportional to the square of the rotor speed. Below this limit, flow rate, discharge pressure, and rotor speed are independent variables. The self-powered, 42-in-high slurry injector vehicle follows and receives run-of-mine coal from a continuous miner, reduces the top size to 3-in, and delivers the sized coal to the injector feed screw

for slurry formation and pumps it through a mobile hose attached to the vehicle's outby end.

22343 **(UCID—20297-85-1) Granular Flow Project quarterly report, January-March 1985.** Walton, O.R. (ed.). (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010015.

We have developed an incrementally-slipping friction model, patterned after theoretical models of frictional contacts, that can produce realistic non-linear friction phenomena. We have incorporated that friction force model in our two-dimensional shearing cell model and have performed a series of calculations of steady state shearing of a single granular material. The shearing cell calculations have verified Bagnold's prediction that shear stress varies as the square of the shear rate for granular solids (even in two-dimensions). The pressure vs volume behavior we calculate for the granular material at a constant shear rate is quite similar to that of an excluded-volume gas at constant temperature. At high densities we find that the granular material in our constant volume calculations tends to form a single shearing layer at the cell boundary with the material inside the cell remaining almost like a crystalline solid. We found that the density at which the transition from uniform shearing to single shearing layer occurs is somewhat dependent on the size and shape of our periodic cell. We are modifying our model to include real boundaries and averaging zones within the calculational cell for material diagnostics. 9 references, 9 figures.

0140 Combustion

REFER ALSO TO CITATION(S) 01400022299, 22844

22344 **(DOE/FE/60181—105) Study of bed agglomeration resulting from the AFBC of low-rank coals.** Bobman, M.H.; Hajicek, D.R.; Zobeck, B.J. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Mar 1985. Contract FC21-83FE60181. 11p. (CONF-850302—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008635.

From 8. international conference on fluidized bed combustion; Houston, TX, USA (18 Mar 1985).

Atmospheric fluidized-bed combustion of high-sodium North Dakota lignite was studied in detail with respect to formation of agglomerated silica sand bed material. Agglomeration of individual bed material particles into larger masses has been observed when firing certain low-rank coals with silica sand or with limestone bed materials. Pilot-scale AFBC and laboratory testing was conducted in an effort to better understand the causes of agglomeration and identify methods for controlling its occurrence. The laboratory testing discussed in this paper consisted of determining the sintering characteristics of bed material samples collected from the pilot-scale AFBC. Agglomeration was found to be significantly affected by the inherent fuel sodium form and content and AFBC operational bed temperature. High sulfur capture was observed in agglomerating runs. Results of sinter tests demonstrated the relationship between agglomerating tendencies and sintering and have identified chemical and physical characteristics which may be important to the agglomeration process.

22345 **(DOE/FE/60181—133) Hydrothermal preparation of low-rank coal/water fuel slurries.** Baker, G.G.; Sears, R.E.; Maas, D.J.; Potas, T.A.; Willson, W.G.; Farnum, S.A. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Mar 1985. Contract FC21-83FE60181. 56p. (CONF-850444—1). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009785.

From Newer coal technologies: implications for energy and development policies in Asia and the Pacific; Honolulu, HI, USA (17 Apr 1985).

Lignite and subbituminous coals are by nature high in inherent moisture and oxygen content and low in calorific heating value. As-mined low-rank coals when mixed with water generally produce slurries with low solids content and with heating values generally less than 5000 Btu/lb. These same slurries are usually unstable and form hard-pack sediments quickly, unless chemical additives or constant agitation are added. The low heating value and poor storage and flow characteristics of these coal/water mixtures discourage the use of raw lignite and subbituminous coals for preparation of slurries for fuel purposes. Hydrothermal conditioning, in a water slurry at temperatures above 240°C and pressures above 800 psig, is one method that can significantly aid in the preparation of low-rank coal-water fuel slurries. High pressure hot-water thermal conditioning of lignites and subbituminous coals has been found not only to change both the chemical and physical characteristics of the coal but also to alter the coal's slurry rheological properties. These changes are controlled by process variables (i.e., temperature, residence time, particle size and mode of processing) and result because of decarboxylation, mild pyrolysis, extraction, dehydration, and surface modification; all of which occur during hydrothermal treatment. Using the hydrothermal process, concentrated low-rank coal/water slurries with heating values approaching or exceeding the heating value of the as-mined coal have been achieved with pseudoplastic flow behavior and stability towards settling, without the use of additives. Pilot scale studies using a 200 lb/hr Process Development Unit (PDU) are currently underway to produce hydrothermally-treated low-rank coal fuel slurries for combustion tests in a pilot-scale, slurry-fed test furnace. 22 references, 7 tables, 10 figures.

22346 **(DOE/PC/40796—11a) Carbon attrition during the fluidized combustion and gasification of coal. Quarterly technical progress report, March 1-May 31, 1984.** Massimilla, L.; Cammarota, A.; Chirone, R.; Miccio, M. (Naples Univ. (Italy)). 1984. Contract FG22-81PC40796. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007649.

The work has been directed to test fragmentation and attrition characteristics of a german anthracite, using the same apparatus and techniques previously described in DOE Reports No. DOE/PC40796-1 and -2. Fragmentation during devolatilization of narrow cut batches and single particles of coal has been investigated. Char particles also have been submitted to fragmentation during combustion experiments. Attrition constants of the anthracite char in batch fluidized bed combustion have been evaluated. Results have been compared to those previously found when using a South African or other bituminous coals (DOE Reports No. DOE/PC40796-3, -7 and -9).

22347 **(DOE/PC/40796—11b) Carbon attrition during the fluidized combustion and gasification of coal. Quarterly technical report, March 1-May 31, 1984.** Massimilla, L.; Cammarota, A.; Salatino, P. (Naples Univ. (Italy)). 1984. Contract FG22-81PC40796. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85007650.

A model is proposed which takes into account the interaction between combustion in the pores, weakening of the mechanical structure of the particle, and attrition during the fluidized combustion of a char. A constitutive relationship between the degree of fragilization of the particle outer region and the rate of regression of the surface is introduced to characterize the behavior of the char in respect to combustion assisted attrition. An orthogonal collocation technique is used to solve model equations. Attrited carbon rates and carbon combustion efficiencies obtained from calculations are compared with those obtained in the batch fluidized combustion of a char.

22348 **(DOE/PC/40796—12a) Carbon attrition during the fluidized combustion and gasification of coal. Quarterly technical report, June 1-August 31, 1984.** Massimilla, L.; Cammarota, A.; Salatino, P. (Naples Univ. (Italy)). 1984. Contract FG22-81PC40796. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007651.

Batch fluidized bed combustion of 5 mm particles of char of the South African bituminous coal already used in this research has been carried out in the 40 mm ID combustor previously described (DOE Reports N DOE/PC40796-1 and -2) to investigate the generation of fines due to the abrasion of bed solids on the surface of burning particles. Experiments have been performed by operating the bed with different oxygen concentration in the fluidizing gas, namely 21, 10, 4.5, 1.4, 0.75 and 0% O_2. Attrition rate constants k obtained working out data collected under these oxidizing conditions are presented.

22349 **(DOE/PC/50808—T4) Elementary processes in combustion and sooting of coal derived fuels. Progress report: 1st year, 4th quarter, May 10, 1983-August 9, 1983.** McVey, J.K. (Princeton Univ., NJ (USA). Dept. of Chemistry). 1984. Contract FG22-82PC50808. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009062.

The objectives are to investigate the kinetics and mechanisms of radical-radical and radical-molecule reactions important in combustion and sooting of high aromatic content fuels. The basic approach involves the initiation of a reaction with laser techniques with subsequent probing of intermediates and products with real-time probes or chemical analysis. Accomplishments for this period are presented for the following projects; (1) reactivity of phenyl radicals; (2) reactions of phenyls ions; (3) reactions of biradicals; and (4) free jet probing of combustion intermediates. Our earlier work on the reactivity of laser-generated phenyl radicals with small organic substrates examined the bulk phase reactions with subsequent monitoring of products using high-resolution ir spectroscopy (FTIR). The role of phenyl radicals in the combustion of high aromatic content fuels and sooting is of prime interest and our studies show rapid dissociation to C_4 species and acetylene and ethylene. Reactions with added quenchers are generally inefficient. Our work on the real time monitoring of the phenyl radical and its precursor, bromobenzene and chlorobenzene, is progressing and we will soon be able to obtain a clearer picture of the phenyl radical chemistry. The technique of multiphoton ionization (MPI) is shown to be highly sensitive and selective as a means of directly following the loss of the bromobenzene precursor and the time dependence of the phenyl radical concentration.

22350 **(DOE/PC/60420—T1) Development of a coal burning vortex containment combustor. Quarterly report No. 1, isothermal testing results and design documentation.** LaFond, J.F.; Chen, S.L.; Heap, M.P.; Seeker, W.R. (Energy and Environmental Research Corp., Irvine, CA (USA)). [1985]. Contract AC22-83PC60420. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009079.

The Vortex Containment Combustor is an advanced cyclonic coal combustor which utilizes design concepts developed by the Department of Defense at Wright-Patterson Air Force Base in the 1960's and early 70's and by EER during recent bench-scale tests. Major features of the VCC design include: Vortex Flow which Reverses on Itself, Long Fuel Residence Time in an Aerodynamic Suspension, Selective Ash Rejection from a Combustion Zone, and Radial Velocity Component of Inlet Air to Prevent Wall Deposition. These features are presented in Figure 1-1. Air flow enters the VCC through tangential slot injectors in a narrow, large diameter region. The air circulates, moves down into a conical section, then reverses upon itself to form an intense high speed vortex core that leaves the chamber. Coal particles are suspended in an active zone away from the exhaust flow. As combustion consumes carbon inert mineral matter remains. The smaller size distribution of the residual ash causes the material to be selectively removed from the active zone. The mineral matter is then centrifugally thrown to the walls of the conical section to form a running slag. Coal particles burn free from the walls, allowing high power densities and much less dependence on coal type. The inlet air is injected with a radial component of velocity to prevent undesirable active zone wall deposition. The program has been approached in a three task format: Design Definition; Prototype Construction and Checkout; and Prototype Testing and Evaluation. The design definition task includes an evaluation of the process requirements which the VCC must satisfy in order to be applied (e.g., turndown ratio, adiabatic operation, pollution control, etc.). Also, design optimization through an isothermal flow modeling and scaling analysis is included in the design definition task. 18 figures.

22351 **(DOE/PC/60420—T2) Development of a coal burning vortex containment combustor. Quarterly report No. 2, an aerodynamic model and construction of the EER vortex containment combustor.** LaFond, J.F.; Heap, M.P.; Lewis, J.E.; Seeker, W.R. (Energy and Environmental Research Corp., Irvine, CA (USA)). [1985]. Contract AC22-83PC60420. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009078.

Aerodynamics plays a dominant role in the performance of the VCC, and the objective of this study has been to produce the insight necessary for a design that has an optimum performance. In particular, given a specific firing rate and ash particle retention, our goal is to minimize the pressure loss. An important EER design tool has been isothermal and pilot-scale model testing and an additional objective of the study has been to predict the relationship between these laboratory tests and a full-scale device. The approach has been to (1) construct an aerodynamic model with all of the controlling physics, but simple enough to allow insight into the role of various design options; (2) use the existing EER laboratory data to validate the model; and (3) use the model to predict the performance of future designs and suggest design improvements. Predictions of the effect of various design parameters on both cold flow and hot flow pressure drop and particulate retention have been made and compared with laboratory data. The theory predicts many of the features and general trends of the data, but fails to properly predict the pressure drop for small exit diameter and small jets (the bench scale model being an exception). An adjustment in the particle size distribution is required to make reasonable particle retention predictions. Further experimentation should illuminate the reasons for these discrepancies. Finally, it is important to recognize that the pressure drop predictions are not inevitable pressure losses; and, in fact, are based on a loss-free theory. To the extent that the theory matches the data, pressure recovery through the use of a diffuser presents itself as a potentially extremely valuable design option. 24 figures.

22352 **(EPRI-AP—3910) Laboratory combustion study of EDS coal-derived liquids. Final report.** Sato, M.; Sema, T.; Ninomiya, T.; Makino, H.; Endo, K. (Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab.). Mar 1985. 86p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920517.

A laboratory-scale evaluation of Exxon Donor Solvent (EDS) coal-derived liquid fuels for use in utility boilers has been made using three types of EDS distillate fuels. The three feed coals were an Illinois bituminous coal, a Wyodak subbituminous coal, and a Texas lignite. The EDS distillate fuels were all supplied by the Electric Power Research Institute (EPRI). The EDS distillate fuels were produced in the Exxon Donor Solvent 200 T/D coal liquefaction pilot plant located in Baytown, Texas, USA. In order to compare the EDS coal-derived liquid fuels with conventional boiler fuels, combustion tests on A- and C-heavy residual oils were conducted. The name A or C refers to the Japanese Industrial Standard. From the study it was concluded that all three coal-derived liquids were practical substitutes for conventional heavy utility boiler fuels. This study was a joint research effort with EPRI. 6 references, 48 figures, 5 tables.

22353 **(EPRI-CS—3812) Gas-cleaning technology for high-temperature, high-pressure gas streams. Annual report.** Ciliberti, D.F.; Lippert, T.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Div.). Feb 1985. 145p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $16.00. File Number TI85920581.

This report presents the results of work accomplished in 1983 under EPRI contract RP 1336-1 on the evaluation and development of hot gas clean up technology for pressurized, fluidized-bed combustion (PFBC). Reported are results of continued testing and evaluation of the woven-ceramic bag filter concept. A theoretical model for pulse jet cleaning is described and correlated with test results. All test work has been conducted on the modified, high-temperature, high-pressure (HTHP) subscale test facility described. Work is also reported on the testing and evaluation of an advanced diagnostic instrument that is being developed to measure directly the deposition and removal of dust cake on the filter bag surface. 15 references, 71 figures, 12 tables.

22354 **(EUR—9396-EN) Development of automatic equipment for coal-fired boilers (Report on ECSC contract 7220-EC/821).** (Commission of the European Communities, Luxembourg). 1984. 63p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Data obtained from an operational survey of boiler houses have been used to derive a mathematical model to predict efficiency changes with boiler load changes and so optimise boiler running conditions. Equipment that has been developed to assist in this optimization includes a combustion controller, a programmable logic controller, automatic electrical ignition for stokers, suction nozzle conveyors for smalls coal handling, a tube conveyor, and a low cost experimental ash sluice rig.

22355 **(NP—4901494) Elutriation rates from fluidized bed combustors and from cold fluidized beds of FBC product particles.** Xu, B.S.; Becker, H.A.; Code, R.K. (Queen's Univ., Kingston, Ontario (Canada)). [1985]. 49p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84901494.
Technical report QFBC.TR.83.2.

Particle elutriation rates were measured in pilot plant trials on the combustion of high-sulphur coal with limestone addition for sulphur capture. A cold-modelling version was also built with which elutriation was studied over a broad range of operating conditions using spent bed material from the pilot plant trials. Attention is particularly focussed on the division of the solids leaving flux between elutriated particles and bed product. For a given particle diameter D/sub p/, this division appears to be determined primarily by the ratio D/sub p//$v^{1.163}$, where v is the fluidizing velocity, and by the recycle level. A generalized correlation of the results is suggested. 21 references, 2 tables, 15 figures.

22356 **(NP—5770251) Investigations of the formation of nitrogen oxides from fuel nitrogen when treating coke in different gas media and at different temperature steps.** Herforth, K.E. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 14 Dec 1982. 266p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE85770251.

It is reported about experiments concerning the formation of nitrogen oxides from organically bound fuel nitrogen by heating coal in different gas media and at different temperatures. Fuels with high and low contents of organically bound nitrogen were analysed and different NOsub(x) formation rates were observed. A three-step course of the conversion of the fuel nitrogen was derived. The NOsub(x) formation was also studied in the fluidized bed combustion and the sintering process of iron ores.

22357 **(NRCC—22859) Pollution potential of peat combustion liquefaction and gasification.** Phinney, K.D. (National Research Council of Canada, Halifax, Nova Scotia). 1983. 87p. National Research Council of Canada, Halifax, Nova Scotia.

This report considers the pollution potential associated with processes for the combustion and conversion of peat into liquid and gaseous fuels. Very limited information is available in the literature concerning the pollution potential of these processes. The use of and technology for combustion of peat is highly developed. This has allowed for a quantitative assessment of the pollution potential of peat combustion processes. This assessment has shown that current and developing pollution control practices for coal and oil fuelled plants in Canada and elsewhere should be directly applicable to peat fuelled systems. Technology for the conversion of peat into liquid and gaseous fuels is at an early stage of development. Consequently, very limited information is available concerning the pollution potential of these processes. The available information, and information for coal conversion processes has been used to provide a qualitative assessment of the pollution potential of peat conversion processes. Further studies will be required to quantitatively assess the potential for pollution following the availability of pilot plant data, and component and heat balances for industrial scale operations.

22358 **(NRCC—23015) Combustion tests - extruded peat sods produced from peat bogs of Lac Saint-Jean region, Quebec.** Marsan, A.. (National Research Council of Canada, Halifax, Nova Scotia). 1983. 25p. National Research Council of Canada, Halifax, Nova Scotia.

The tests reported led to useful conclusions for anyone considering peat as fuel. For low moisture content (m.c.) (15%), steam production is about 7 lbs per lb. of peat. This low m.c. however, involves considerable particulate emissions which can be avoided by using peat at about 40% m.c. with steam production at about 5-6 lbs. per lb. of peat. The calorific value of 40% m.c. peat is equal to that of 50% m.c. wood waste, assuming the same combustion efficiency. Steam production from sod peat, including its production costs, is about dollars 2.00/10/SUP/6 BTU.

22359 **(PB—85-126308/XAB) Testing of limestone samples from the TVA (Tennessee Valley Authority) region as sulfur dioxide sorbents in atmospheric fluidized bed combustors. Final report.** Hasler, J.R. Jr.; Robl, T.L.; Adibhatla, S.; Cunningham, R.D.; Withers, H.W. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research; Tennessee Valley Authority, Chattanooga (USA)). Apr 1984. 69p. (IMMR—82-077). NTIS, PC A04/MF A01.

Prepared in cooperation with Tennessee Valley Authority, Chattanooga. Sponsored in part by Kentucky Energy Cabinet, Lexington.

This project summary presents the results from a two-year study of 37 limestone and dolomite samples for application as bed materials in Atmospheric Fluidized Bed Combustion (AFBC). The Tennessee Valley Authority (TVA) supplied the limestone samples for this study. The materials represent a cursory survey of what is currently available from quarries in the region surveyed by the TVA. The following nine techniques were used to characterize the limestone samples: (1) petrographic analysis (2) chemical analysis, (3) thermogravimetric analysis (TGA), (4) attrition test, (5) Brunauer, Emmett, and Teller (BET) surface area, (6) mercury porosimetry, (7) density measurements, (8) transmission electron microscopy (TEM) and (9) scanning electron microscopy (SEM). In addition, both the sensitivity of stone sulfation capacity to temperature changes and the possibility of using hydration to enhance limestone sulfur-capture capability were examined. TVA-804, 806, 819, and 829 are the limestones the authors recommend for AFBCs. Their results indicate that thermogravimetric analysis (TGA) is the simplest means of determining the relative sulfur capture capacity of the limestones. The attrition/sulfation test is a good indicator of sulfur capture, attrition, and carry-over properties of the bed material. TEM analysis of calcined stones is useful in ranking stones in order of sulfur capture capacity; however, like the TGA and attrition test data, TEM analysis cannot provide quantitative results.

22360 **(STF—15A83031) Practical experience from coal fired boilers - underfeedstokers.** Hustad, J.; Utne, Aa. (Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway)). Jun 1983. 35p. (In Norwegian). Selskapet for Industriell og Teknisk Forskning, Trondheim, Norway.

The report comprises one year operational experience of coal using boilers as heaters for greenhouses at three market gardens in Lier (Norway). The experiences are based on technical inspections and combustion measurements on the plants and also conversation with consultants and gardeners. The economic results are good and the time of repayment is at best 13 months. The technical combustion results, concerning two of the boilers, are very good and the efficiencies are up to 85-86%. The measured results have lead to recommendations about suitable coal qualities and the most favourable operating conditions of the plants. Experiences of the coal transport system are mostly good but some components proved unsuitable for coal transport. (In Norwegian)

22361 **Studies of sintering of coal ash relevant to pulverized coal utility boilers 1. Examination of the Raask shrinkage-electrical resistance method.** Conn, R.E.; Austin, L.G. (Fuel Science Section The Pennsylvania State University, University Park, PA). *Fuel;* **63**: No. 12, 1664-1671(Dec 1984).

The Raask shrinkage and electrical resistance method for determining the onset of sintering of fly ash has been tested on a soda lime glass, coal ASTM ashes, fly ashes and pulverized synthetic mineral mixtures. Results with the glass confirmed those of Raask and showed that particle size distribution and bulk density affected the resistance values: the sinter point was indicated by a change in the characteristic temperature coefficient of resistance. The shrinkage and electrical sinter points were usually the same, but a high Na content lignite gave 850°C for shrinkage but 600°C for characteristic resistance change. Sinter points were 200°C less for fly ash

than for ASTM ash. The fly ashes had a slight enrichment of alkalies and a decrease in Fe content compared to the total ash. Holding a compact at a temperature above the sinter point gave increased strength and shrinkage, but no decrease in electrical resistance, indicating that the decrease in resistance as temperature increased was due to the establishment of contact points between particles, with little effect of the continued growth of a contact neck. Addition of pulverized sodium silicate or iron silicate glasses to a synthetic ash also reduced the sinter points, as did alkali additions, whereas addition of pyrite did not. It was concluded that the method was a valuable tool, but sources of variability had to be determined and controlled.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 01500022295, 22498

0160 Health And Safety

REFER ALSO TO CITATION(S) 01600022936

22362 (ANL/ES—144) Development of a methane monitor meeting the Bureau of Mines' Intrinsically Safe Mine Monitoring System (ISMMS) requirements. Otagawa, T.; Zaromb, S.; Stetter, J.R. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009663.

A low-current methane monitor was constructed that meets the Bureau of Mines' Intrinsically Safe Mine Monitoring System (ISMMS) requirements. Methane is directly oxidized using a highly oxidizing working-electrode potential and a nonaqueous electrolyte. The output of the two sensors is balanced to compensate for background current variations. The response of the monitor is substantially proportional to methane concentration over 0 to 100% methane. The best sensitivity and stability were obtained with an electrode composed of platinum black with a 35 wt % Teflon dispersion deposited on a porous Teflon membrane in contact with 2 M $NaClO_4$ in γ-butyrolactone. A working-electrode potential of 800 mV versus Ag/AgCl gave the best sensitivity and stability at various relative humidities, whereas a potential of 600 mV versus Ag/AgCl gave the highest signal-to-background-current ratio. The best wicks combined a sintered glass disk and glass fiber filters. The response time is less than 1 min to 90% of signal at a flow rate of 100 cm^3/min. Concentrations as low as 0.6% methane in air could be distinguished from background. The sensitivity and background current of the sensors depend on temperature, with large changes in temperature causing a drift in the background current. 23 references, 27 figures, 10 tables.

22363 (CONF-8403150—) Proceedings of the DOE-OHER workshop on monitoring and dosimetry in an occupational health research program for synfuel technologies. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 83p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85008230.

From DOE-OHER workshop on monitoring and dosimetry in an occupational health research program for synfuel technologies; Knoxville, TN, USA (20 Mar 1984).

Several areas of research related to the improvement of occupational health protection for workers in a synthetic fuels industry were identified. Research in the areas of fugitive emissions, skin contamination, biological monitoring, and chemical dosimetry was recommended. Included papers have been individually entered into the data base. (ACR)

22364 (PB—85-145787/XAB) Analysis of economic impact of fatal/nonfatal accidents in surface coal and metal/nonmetal mines. Open file report, 5 January-28 October 1983. Di Canio, D.G. (SRI International, Menlo Park, CA (USA)). Nov 1983. 145p. NTIS, PC A07/MF A01.

The report describes a computer-based accident cost indicator model (ACIM) for estimating tangible costs of occupational injuries, illnesses, and fatalities in the U.S. mining industry. The report includes studies performed to expand the scope of the ACIM to all mining sectors and validation of ACIM cost element estimation algorithms with actual costs of mining-related injuries and illnesses. A study of the effect of a fatal accident on production in surface coal and metal-nonmetal mines, based on samples of 15 fatalities in underground and surface mines, is presented. Evidence of significant long-term decline in postfatality production at six of eight underground samples is included. The average loss is shown to be 1.8% of annual mine production. A study of accident costs in U.S. mining from 1975 through 1981 using the ACIM indicates that total annual costs increased from $180,000,000 in 1975 to $379,000,000 in 1981, a 15% annual increase after adjusting for inflation, with mining companies bearing 45% of the total and expected wage losses to mining families accounting for 42%. The study shows total costs of $12,400 per accident and $674,000 per fatal accident for 1981.

0170 Legislation And Regulations

22365 (PB—85-138097/XAB) Assessment of Development and Production Potential of Federal Coal Leases. Volume 2. Working papers. Part A. The development prospects for federal coal leases in Colorado 1980-1991: results of Colorado coal-leasing task force. (Dames and Moore, Denver, CO (USA)). Jun 1984. 258p. NTIS, PC A12/MF A01.

See also PB83-180901 and PB85-138105. Sponsored by Office of Technology Assessment, Washington, DC. Portions of this document are not fully legible.

These working papers contain papers for OTA to assist in preparation of the report An Assessment of Development and Production Potential of Federal Coal Leases. This paper concerns development prospects for federal coal leases in Colorado.

22366 (PB—85-138105/XAB) Assessment of Development and Production Potential of Federal Coal Leases. Volume 2. Working papers. Part 1, Vol. 1. Analysis of federal coal leases in mine plans in Colorado, New Mexico, Oklahoma, and Utah. (Dames and Moore, Denver, CO (USA)). Jun 1984. 89p. (R—10697-004-14). NTIS, PC A05/MF A01.

See also PB85-138097. Sponsored by Office of Technology Assessment, Washington, DC.

These working papers contain papers written for OTA to assist in preparation of the report An Assessment of Development and Production Potential of Federal Coal Leases. This paper includes analysis of federal coal-lease mine plans in Colorado, New Mexico, Oklahoma, and Utah.

22367 (PB—85-147312/XAB) Hydrologic considerations in federal coal leasing. Van Haveren, B.P.; Koss, L.C. (Bureau of Land Management, Denver, CO (USA)). 1980. 8p. (R—33-80). NTIS, PC A02/MF A01.

The Bureau of Land Management is faced with the task of leasing hundreds of millions of tons of Federal coal over the next few years. New legislation and departmental and agency policy directives dictate that water-resources values will be carefully considered and accounted for before leasing can occur. BLM hydrologists, with assistance from hydrologists of the US Geological Survey, have designed and implemented a system for collecting and interpreting the necessary hydrologic data from previously ungaged basins, predicting the potential impacts of surface mining and associated leasing activities, and finally making a recommendation to the land manager relative to the water resource. The BLM initiated in 1975 a program to provide the land manager with an assessment of the mined-land rehabilitation potential and recommendations for reclamation methods and procedures for potential coal lease areas.

02 PETROLEUM

REFER ALSO TO CITATION(S) 02000022272, 22273

0203 Drilling And Production

22368 (DOE/SF/11564—10) Computer analysis of thermal recovery well test data. Barua, J.; Horne, R.N. (Stanford Univ., CA (USA). Petroleum Research Inst.). 1985. Contract AC03-81SF11564. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000127.

The radius of the swept zone is an important parameter in secondary recovery by thermal methods. There have been several methods proposed to determine this parameter from well tests performed on the injection well. Perhaps the most powerful method presently is the pseudo-steady state analysis method where a straight line is found on a plot of well data on Cartesian axes. This method is only valid for the case where there is a high mobility ratio between the swept and unswept zones. Though it has been extended to the case of a low mobility ratio, analysis then becomes virtually impossible. Automated type-curve match offers a new way to analyze well test data. Laplace space determination of parameter gradients allows type-curve match to the most complex of mathematical models. This study shows that automated type-curve match to the two-zone reservoir model can be used to analyze well tests on thermal recovery injection wells. A comparison with the best of present methods, i.e., the pseudo-steady state method, shows that automated type-curve match proves to be better in the determination of swept zone radius when mobility ratio is not high or when multiple flow rates have occurred. In addition automated type-curve match can, in some cases, estimate unswept zone parameters like mobility and porosity-compressibility product. The application of automated type-curve match to two field examples is demonstrated. 11 references, 50 figures, 4 tables.

22369 (LBL—18947) Dynamics of thin-film breakup in a constricted pore. Gauglitz, P.A.; Radke, C.J. (California Univ., Berkeley (USA). Dept. of Chemical Engineering). 1985. Contract AC03-76SF00098. 17p. (CONF-850357—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008442.

From Spring national meeting of AIChE; Houston, TX, USA (24 Mar 1985).

To understand foam formation in porous media, this work considers the dynamics of a wetting liquid film forming an unstable collar (or collars) in a constricted cylindrical tube. A hydrodynamic lubrication analysis is presented to describe the time evolution of a thin viscous film under the influence of surface tension and conjoining or disjoining forces. Time to breakup depends on the pore shape, the strength of the conjoining or disjoining force, the initial film profile, and also, the fluid viscosity, interfacial tension, and unconstricted pore radius which combine to form a characteristic scaling time. Agreement is found between breakup times predicted from the hydrodynamic analysis, and from 16 mm movies taken of the breakup phenomena over a wide range of initial film thicknesses. 11 references, 5 figures.

22370 A model for forecasting the economic potential for enhanced oil recovery in Canada. Bing, P.C.; Bowers, B.; Lomas, R.M. (Energy Supply Branch, National Energy Board, Ottawa). *Journal of Canadian Petroleum Technology;* 23: No. 6, 44-55(Dec 1984).

A model for the economic evaluation of enhanced oil recovery projects is described in this paper. It incorporates recent work done under the sponsorship of the United States Department of Energy to estimate incremental oil recovery from the various enhanced oil recovery processes. The EOR processes considered in the model are steam drive, in-situ combustion, carbon dioxide miscible, hydrocarbon miscible, surfactant (micro-emulsion) flood, alkaline flood, and polymer-assisted waterflood. The model predicts incremental enhanced oil recovery, and generates injection and production profiles. Economic viability is determined incrementally, by comparing a pool's economic performance with implementation of an EOR project to the pool's economic performance in the base case, without implementation of an EOR project. This approach permits correct modelling of the different price, royalty and fiscal incentives available for EOR projects.

0204 Processing

REFER ALSO TO CITATION(S) 02040022382

22371 (DOE/NBM—5000125) Metal coordination chemistry: removal and recovery of metal compounds from heavy crude and shale oil with multidentate ligands. Annual report, October 1983-October 1984. Fish, R.H. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000125.

The removal and recovery of trace-metal compounds in complex matrices, such as heavy crude petroleums and shale oils, is a basic problem in the general area of fundamental petroleum chemistry. We are developing innovative methods to remove arsenic compounds from shale oil and vanadium and nickel compounds from heavy crude petroleums. This involves placing ligands onto polymers that will react with the trace-metal compounds present in these matrices. As well, studies directed toward the molecular characterization of the trace-metal compounds in the above-mentioned petroleums allows selective methods to be utilized in the polymer pendant ligand experiments designed to remove these trace-metals. In this annual report, we will demonstrate the use of polymer pendant catechol ligands in removal and recovery studies using arsenic compounds that were characterized in Green River Formation oil shale and its pyrolysis products. In addition, the evaluation of a new ligand for arsenate removal will also be discussed. The molecular characterization of metallo-non-porphyrin compounds of vanadium and nickel in petroleums and their asphaltenes will also be addressed to clearly demonstrate the need to understand these complex mixtures and to use this knowledge for exploration, catalyst poisoning and removal studies that will directly benefit the petroleum industry. 68 references, 17 figures, 7 tables.

22372 (PB—85-147718/XAB) Natural gas consumption in US refineries. Final report, March-September 1984. Frederick, F.P. (Bonner and Moore Management Science, Houston, TX (USA)). Sep 1984. 176p. NTIS, PC A09/MF A01.

The U.S. refining industry utilizes various types of energy in the manufacture of petroleum products from crude oil. Natural gas has been preferentially utilized for some manufacturing processes. With changes in the energy industry (pricing of fuels, introduction of new technology and alteration in government policies and fuels availability, the demand for natural gas as a refinery fuel has also changed. This report analyzes changes which have occurred and projects the demand for natural gas to the year 2000. The analysis places the demand forecast in regional perspective by using data from various Petroleum Administration for Defense Districts (PADDs) which were used as geographical units for gas demand analysis/reporting.

0205 Products And By-products

REFER ALSO TO CITATION(S) 02050022375

0207 Marketing And Economics

22373 (DOE/EIA—0380(84/09)) Petroleum Marketing Monthly, September 1984. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Nov 1984. 134p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE85004291.

This report presents monthly summaries of petroleum product marketing statistics for the US, Petroleum Administration for Defense (PAD) Districts, and individual States. Four types of petroleum product statistics are included: sale prices, sale volumes, percentages of product sales, and first sales of products for consumption. Salient statistics are highlighted in a summary section, and each of the four subjects are treated in detail in other sections. The first tables in each of the first three section provide national-

level statistics on sales of the various products to end-users and for resale. The following tables provide finer geographic and type of seller detail and are grouped by product, beginning with motor gasoline and ending with either residual fuel oil or propane. The majority of the tables show data for the report month and previous month for the current year. Data on motor gasoline, aviation fuel, jet engine fuel, kerosene, distillate fuel oils, residual fuel oils, and propane are included. A glossary is included.

22374 **(DOE/PE/70040—1) Changing structure of the world refining industry: implications for the United States and other major consuming regions.** (Resource Systems Inst., Honolulu, HI (USA)). Feb 1985. Contract FG01-82PE70040. 215p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85010321.

There are five chapters in this publication. Chapter I on refining industry in transition covers refining history highlights, and OPEC's downstream operations. Chapter II on demand for oil and oil products discusses supply and demand for OPEC oil, demand for oil products, historical growth trends, future growth trends and the case of East Asia - emergence of a fuel oil glut. Chapter III on the US and other traditional refining centers begins with an introduction on the structure of refining and continues on to cover the refining industry in OECD countries, USA, Western Europe, Japan, Singapore and Caribbean and closes with some conclusions. Chapter IV is on refining expansions in OPEC and the third World Nations. The following are covered: (1) nations of the Gulf (Saudi Arabia, Kuwait, Iran, Iraq, Bahrain, Qatar, Oman, United Arab Emirates); (2) OPEC members beyond the Gulf (Indonesia, Africa, Libya, Algeria, Nigeria and Gabon, South America, Venezuela); (3) other major exporters (China, Egypt, Malaysia, Mexico); (4) non-OPEC developing countries - trends in the refining sector. The chapter ends with a short summary on capacity prospects and comparative economics. The final chapter has conclusions and recommendations on: price interactions between crude and products; product exports - impact on OPEC's internal; prices and market influence; importers and exporters - decisions; and course of action of the United States. 18 figures, 40 tables.

22375 **(DOE/PE/70040—2) Appendix I: developments in the petrochemical sector.** (Resource Systems Inst., Honolulu, HI (USA)). Feb 1985. Contract FG01-82PE70040. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010328.

The new Gulf chemical producers have a solid cost advantage over OCED companies and over producers elsewhere. This advantage is much stronger than the questionable economics of Gulf refining; these ventures are relatively sound investments from a purely commercial point of view. Most of what has been said about refining applies here as well, however: (1) Asia, and to a lesser degree, Western Europe, are far more attractive markets than the US. If products flowed to the points of maximum netbacks, little would arrive in the US. (2) The heavy involvement of US companies in Saudi joint ventures is likely to bring significant quantities of chemicals into the US for captive consumption in the companies downstream operations. This is particularly true of the more easily transported liquid chemicals; Shell US, the partner in the SADAF project at Jubail, will probably bring a major proportion of its output of styrene and ethanol into the US. (3) As in refining, larger quantities of chemicals could be diverted to the US economy by trade barriers and poor economic conditions in other countries. The impact of these possible imports on the US is far lower, however, than in refined product imports. First of all, it is difficult to argue that such imports may have a substantial effect on US security. Second, the Gulf industry can hardly be considered a serious competitor to the overall US chemical industry; the Gulf will be exporting only a small range of basic, bulk chemicals, while the US produces the widest array of sophisticated products in the world. There are few arguments for new trade measures against emerging chemical imports from the Gulf. As in other sectors, US interests are likely to be served by encouraging freer trade and more international competition in this market. 7 figures, 12 tables.

22376 **(NP—5901291) 1982 oil and gas production in Kansas.** Paul, S.E.; Beene, D.L. (Kansas Geological Survey, Lawrence (USA)). 1983. 263p. Kansas Geological Survey, Univ. of Kansas, 1930 Constant Ave., Lawrence, KS 66046. File Number TI85901291.

Energy resources series 23.

Crude oil production in Kansas during 1982 rose to 70,525,451 barrels (bbs), an increase of 7.2% over 1981 and the states highest production in 10 years. Natural gas production, however, peaked in 1970 when 904.5 billion cubic feet were reported. That peak was followed by an almost continous decline caused by a variety of economic problems. In 1982, production declined to 425.2 billion cubic feet, 34% below 1981 production. Tables are presented in this publication showing: oil production in 1982 by countries; natural gas production in 1982 by counties; comparison by county of 1982 and 1981 oil production and producing wells; comparison by county of 1982 and 1981 gas production and producing wells; list of new-field discovery wells; well completion summary, 1982; and eleven most significant established fields in 1982.

0208 Waste Management

REFER ALSO TO CITATION(S) 02080022324

22377 **(PB—85-148708/XAB) Land treatment of petroleum-refinery sludges. Final report, April 1980-June 1983.** Streebin, L.E.; Robertson, J.M.; Schornick, H.M.; Bowen, P.T.; Bagawandoss, K.M. (Oklahoma Univ., Norman (USA). School of Civil Engineering and Environmental Science). Nov 1984. 333p. NTIS, PC A15/MF A01.

Petroleum API Separator sludge was applied to field plots to evaluate optimization of loading rates and frequencies for waste disposal by land treatment. Loading rates 3 to 13 wt. % and frequencies 1 to 12, respectively, per year were studied over an 18 month period. Total oil losses were proportional to the amount applied and averaged 54% over the study period. Saturates fraction loss was highest followed by aromatics, polars, and asphaltenes. Volatile losses were substantial at application, but relatively small over the long-term. Biodegradation of the oil followed first order kinetics with a rate coefficient of 0.003/day. Heavy metals were immobile in the top 30 cm zone of incorporation. Facility design factors are discussed relating to field equipment operation, oil percolation prevention, runoff control, and proper tillings.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 02090022392

22378 **(DOE/PO/10850—4-Vol.1) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Annual report for the Bryan Mound site, September 1983-August 1984. Volume 1.** Harper, D.E. Jr.; Jeffrey, L.M.; Kelly, F.J. Jr.; Landry, A.M.; McKinney, L.D.; Randall, R.E.; Slowey, J.F.; Wolff, G.A. (Texas A and M Univ., College Station (USA). Research Foundation). Mar 1985. Contract AC96-83PO10850. 499p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE85009906.

The Department of Energy's Strategic Petroleum Reserve Program has been discharging brine into the coastal waters offshore of Freeport, Texas since March 10, 1980. This report describes the findings of a team of Texas A and M University scientists and engineers who have conducted a study to evaluate the effects of the Bryan Mound brine discharge on the marine environment during the period from September 1983 through August 1984. The study addresses the areas of physical oceanography, brine plume, water and sediment quality, nekton, benthos and data management. The ambient physical environment and its temporal and spatial variability were studied by means of continuously recording in situ current/conductivity/temperature meters and twelve, one-day synoptic hydrographic cruises. The quarterly water and sediment quality data show that a small increase in the salinity and the sodium and chloride ions occurs in the bottom waters and sediment pore waters near the diffuser relative to those values measured at stations far-

ther away. Data from the brine plume study show the maximum areal extent within the +.1% above ambient salinity contour was 45.0 km^2 and the highest measured salinity was 3.97%. The nekton investigations show that the brine disposal at Bryan Mound has resulted in no profound disruption of the overall nekton community inhabiting the diffuser area. The benthic quarterly data from 26 stations, including 11 collections made after the diffuser outflow rate was increased to 1,000,000 barrels/day, show the total numbers of species were depressed in an arc around the diffuser, but not at the diffuser station. In contrast, the total abundances at the diffuser station were depressed, and a zone of enhancement occurred in an arc around the diffuser. 139 references, 191 figures, 48 tables.

22379 **(DOE/PO/10850—4-Vol.2) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Annual report for the Bryan Mound site, September 1983-August 1984. Volume II.** Hann, R.W. Jr.; Giammona, C.P.; Randall, R.E. (eds.). (Texas A and M Univ., College Station (USA). Research Foundation). Mar 1985. Contract AC96-83PO10850. 443p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85009905.

The Department of Energy's Strategic Petroleum Reserve Program has been discharging brine into the coastal waters offshore of Freeport, Texas since March 10, 1980. This report describes the findings of a team of Texas A and M University scientists and engineers who have conducted a study to evaluate the effects of the Bryan Mound brine discharge on the marine environment during the period from September 1983 through August 1984. Volume II contains appendices for the following: (1) supporting data for physical oceanography; (2) supporting data for brine plume measurements; (3) supporting data for water and sediment quality; (4) supporting data for nekton studies; and (5) Bryan Mound discharge data. 254 figures, 95 tables.

22380 **(DOE/PO/10850—4-Vol.3) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Annual report for the Bryan Mound Site, September 1983-August 1984. Volume III.** Hann, R.W. Jr.; Giammona, C.P.; Randall, R.E. (eds.). (Texas A and M Univ., College Station (USA). Research Foundation). Mar 1985. Contract AC96-83PO10850. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009907.

The Department of Energy's Strategic Petroleum Reserve Program has been discharging brine into the coastal waters offshore of Freeport, Texas since March 10, 1980. The purpose of this executive summary is to describe the findings for the 12 months of post-disposal study conducted from September 1983 through August 1984. The areas of investigation are benthos, brine plume, data management, nekton, physical oceanography, and water and sediment quality. The specific objectives of this report are: (1) to describe the physical oceanographic and meterological conditions which have been measured at the offshore diffuser site and in the surrounding waters; (2) to describe the effect of brine discharge on the benthic community in the diffuser site area; (3) to discuss the effect of the brine discharge on the quality of the water and sediment in the vicinity of the diffuser site; (4) to describe the measurement and empirical prediction of the areal extent, vertical extent, and the above ambient salinity of the brine plume; and (5) to characterize the effect of brine discharge on the nekton community in the vicinity of the diffuser. 2 figures.

22381 **(PB—85-121713/XAB) OHMSETT (Oil and Hazardous Materials Simulated Environmental Test Tank) skimmer test in ice-infested waters.** Shum, J.S.; Borst, M. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Nov 1984. 19p. NTIS, PC A02/MF A01.

The increase in petroleum-development activities in the Arctic region has raised concerns over potential oil spills during the broken-ice season. Currently, exploratory drilling for oil and gas is restricted during this season due to the lack of oil-spill cleanup methods that have been proven effective in broken-ice fields. Test programs have been conducted at the United States Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank to determine the feasibility of cold-weather testing; and to evaluate various oil spill cleanup methods that are being considered for use in the Arctic. This paper describes a test program conducted to determine the practicality of using a catamaran-mounted rope mop skimmer for spill cleanup in broken ice fields.

22382 **(PB—85-122232/XAB) Cost of control of sulfur dioxide, nitrogen oxides, and particulates emissions from large combustion plants in oil refineries.** Sutherland, H.; Capron, P.; Cerase, A.; Foster, F.O.; Hey, H.W. (Concawe, The Hague (Netherlands)). [1984]. 34p. NTIS, PC E04/MF E01.

This report presents the results of a study on the cost of controlling emissions of SO_2, NOx, and particulates from oil refineries by flue-gas treatment. Reductions of emissions have been chosen in accordance with those proposed by the European Commission's Directive Limitation of the emission of pollutants into the air from large combustion plants. The report calculates the retrofitting cost for the average CONCAWE refinery and the total cost for all EEC refineries. A short review of available emission reduction techniques is also included. (Copyright (c) CONCAWE Den Haag September 1984.)

0230 Properties

REFER ALSO TO CITATION(S) 02300022936

22383 **Characterization of heavy oil.** Yen, T.F. (Univ. of Southern California, Los Angeles). pp 412-423 of The future of heavy crude and tar sands. Meyer, R.F.; Olson, J.C.; Wynn, J.C. New York, NY; McGraw-Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

Oil from heavy crude, tar sands, and various other bituminous deposits can best be characterized by a number of physical and chemical methods. The conventional viscosity and density indicators are no longer sufficient to define the nature and properties of the various organic constituents of these bituminous accumulations. A simple separation scheme is possible for the fractionation of heavy oils into various cuts using differences in relative volatilities, solubility parameters, and polarity. All types of heavy oil can be fractionated into volatiles, gas oil, resin, asphaltene, and carbenecarboid fractions. Simple structural parameters derived by methods such as elemental analysis, VPO molecular weight, ^{1}H-NMR, and IR are sufficient to derive a tentative, average, hypothetical molecular structure for any fraction of a given oil. Additional structural parameters, including those determined by x-ray diffraction, ^{13}C-NMR, ESR, resistivity, UV-visible, DTA-TGA, refractive index, HPLC, etc., can help to further refine this hypothetical average molecular structure. This multivariant matrix form of structural parameters of a given fraction, plus the relative amount of each fraction in a particular oil, can be used to predict the geochemical genesis of the oil, such as depositional history, paleo environment, precursor sources, maturation, geochemical transformations, etc. Such a characterization of the heavy oil component properties can be also used to determine important processing variables such as HDS catalyst types, operating temperatures, preasures, and space velocities. The choice of environmental monitoring options as well as the selection of appropriate pollution control technology could be decided on the basis of such an analysis.

0240 Storage

REFER ALSO TO CITATION(S) 02400022378, 22379, 22380

0250 Combustion

REFER ALSO TO CITATION(S) 02500022352

03 NATURAL GAS

REFER ALSO TO CITATION(S) 03000022272

0301 Reserves

REFER ALSO TO CITATION(S) 03010022385

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 03020023181

22384 **(DOE/METC—85-7) Third annual Western Gas Sands Program review.** Frohne, K.H. (USDOE Morgantown Energy Technology Center, WV). Nov 1984. 535p. (CONF-8411101—). NTIS, PC A23/MF A01; 1; GPO Dep. File Number DE85001961.

From 3. annual western gas sands sub-program review; Morgantown, WV, USA (7 Nov 1984).

The Western Gas Sands research project is a part of the Department of Energy's Unconventional Gas Recovery Program, managed by the Morgantown Energy Technology Center. The goal of the research is to build the scientific and engineering knowledge base for the production of natural gas from unconventional resources found in complex geologic environments and representing high technical risk. Research is currently focused on resolving the technical uncertainties in order to encourage development of these resources by the private industry sector. The Third Annual Western Gas Sands Program Review was held in Morgantown, West Virginia, on November 7 an 8, 1984. The objectives of the conference were: To review the technical performance and current status of Western Gas Sands research in Fiscal Year 1984. To foster interdisciplinary technical information exchange between researchers from the geological, generic, and production research elements of the project. To provide planning information for advancement of Western Gas Sands research. Fifty-three individuals from academia, government, and national laboratories participated in the review. Twenty-two presentations which were made during the one and one-half day conference, are included in this proceedings. All of these papers have been processed for inclusion in the Energy Data Base.

22385 **(DOE/METC/SP—216) Eastern gas shales.** (USDOE Morgantown Energy Technology Center, WV). Feb 1985. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001983.

Eastern Gas Shales research has for its goal the development of scientific and engineering knowledge to permit the recovery of natural gas from shale formations that underlie the Appalachian, Illinois, and Michigan Basins. As information was gathered on the geology and chemistry of gas-bearing Devonian shales, studies of well completion and stimulation methods were conducted in the laboratory as well as in the field. Key accomplishments in geologic research are as follows: Geologic and geochemical studies estimated gas resources in place to be 2500 trillions of cubic feet (Tcf) in Appalachian Basin, 85 Tcf in the Illinois Basin, and 76 Tcf in the Michigan Basin. Shale gas resources in the Appalachian Basin were appraised to be between 577 and 1131 Tcf. Screening reports identifying areas favorable for shale gas discovery and development were published and distributed. Over 150 new geologic maps were prepared and distributed to guide shale gas exploration. Geologic and geochemical analyses for 35 cored wells were compiled and published. Key accomplishments in reservoir assessment, diagnostics, fracturing, and production research are as follows: A wireline tool was designed for measuring rock stress at multiple depths in the borehole. The tailored pulse method of stimulation was developed and tested. Guidelines were established for selecting a stimulation method in various regions through the analyses of 95 tests. It was established that prospects for infill well development are widespread. Predictive capability was developed for dual-porosity, dual-permeability shale reservoir. Key accomplishments in technical integration and evaluation are as follows: Completed estimates of technically recoverable gas resources in Ohio for selected stimulation methods. The Drilling Decision Tree System was completed and sent to the National Energy Software Center along with its users manual. 5 figures, 3 tables.

0303 Drilling, Production, And Processing

22386 **(PB—85-149748/XAB) Energy flowmeter development, Phases 1 and 2. Final report, January 1982-May 1984.** Clingman, W.H.; Hall, K.R. (Precision Machine Products, Inc., Dallas, TX (USA)). Jun 1984. 50p. NTIS, PC A03/MF A01.

An energy flowmeter has been developed and a first prototype successfully tested at a natural gas desulfurization plant. This prototype directly measures the rate of energy delivered to a gas-fired furnace without having to separately determine the volumetric flow rate and heating value of the gas. By replacing two measurements with one, it is expected to lower the cost of the equipment required, increase reliability, and more accurately measure energy delivered.

0305 Health And Safety

REFER ALSO TO CITATION(S) 03050022390

22387 **(PB—85-159465/XAB) Thermal radiation from LNG trench fires. Volume 2. Data. Final report, September 1982-September 1984.** Moorhouse, J.; Croce, P.A. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Sep 1984. 297p. (ADL—88682). NTIS, PC A13/MF A01.

See also PB85-129096.

The current federal regulations for LNG facilities require a thermal radiation exclusion zone for public safety around spill-impoundment systems. The size of this zone is determined by applying a thermal-radiation model that was developed for large circular or near-circular pool fires. Since trench (elongated pool) fires behave differently from circular pool fires, an experimental test program was conducted to monitor the fire behavior and thermal radiation from large-scale LNG trench fires. This volume presents all of the data obtained from the trench fire experiments. Details of each experiment, the various types of instrumentation employed, their method of calibration, and data analysis techniques are described in Volume I of this report, along with a discussion of project results, including a new trench fire radiation model.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 03060022372, 22376, 22743

22388 **(BNL—35963) Modeling natural gas demand at the state level.** Wade, S.H.; Minasi, M.J.; Carr, K. (Brookhaven National Lab., Upton, NY (USA)). May 1984. Contract AC02-76CH00016. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009825.

This paper discusses preliminary results for a model of residential natural gas demand at the state level. The model consists of two stages. The first determines the number of gas customers; the second stage estimates consumption per customer. The primary data source is the Energy Information Administration's (EIA) State Energy Data System (SEDS). The SEDS data are annual observations from 1960 through 1981 and include consumption and revenue data for the primary residential fuels. These data have been augmented with population, disposable personal income, number of customers, weather and climate data. 12 references.

22389 **(PB—85-149805/XAB) Factors affecting the competitive position of natural gas in industrial heat applications. Topical report, March 1983-September 1984.** Desai, T.M.; Salama, S.Y.; Duleep, K.G.; Venkateshwara, B.; Forshay, P.H. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Sep 1984. 178p. NTIS, PC A09/MF A01.

Gas use in industrial process-heat market is expected to face increased competition from technologies based on alternate energy sources. The diversity in process-heat applications makes it necessary to examine industrial process heating at a disaggregated level to assess the competition faced by gas technologies and to explore R and D concepts to improve gas competitiveness. Thirty-eight subcategories have been developed, each with common technology competition issues. The energy and natural gas consumptions in each of these subcategories are estimated. The competition faced by gas technologies from electric and coal technologies is assessed and each subcategory is classified as safe, uncertain, or vulnerable based on the degree of competition. The natural gas consumption for process heat is divided between the three classifications as follows: 41 percent as safe, 26 percent as uncertain, and 33 percent as vulnerable. Issues affecting the selection of gas versus oil and trends influencing gas consumption are addressed whenever relevant.

0308 Environmental Effects

REFER ALSO TO CITATION(S) 03080022387

22390 **(PB—85-148468/XAB) Mechanisms of heat and mass transfer across a double-diffusive interface. Final report, September 1978-August 1984.** Ko, B.H.; Smith, K.A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). Jun 1984. 45p. NTIS, PC A03/MF A01.

Flux measurements in an aqueous two-layer double-diffusive system using heat and NaCl confirmed the existence of a regime in which the ratio of the buoyancy fluxes (BFR) of salt and heat is independent of the stability ratio (R = beta(delta C)/alpha(delta T)). Linear analysis showed that the quiescent system can become unstable to small perturbations even when the lower layer is denser than the upper. If R is large, the most unstable mode presents as an oscillatory, antisymmetric pattern.

22391 **(PB—85-149821/XAB) Development of polymer concrete for dike insulation at LNG (Liquid Natural Gas) facilities. Final report, August 1983-July 1984.** Fontana, J.J.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Nov 1984. 51p. NTIS, PC A04/MF A01.

Prepared in cooperation with Associated Universities, Inc., New York.

An insulating polymer concrete (IPC) composite has been developed for possible use as a dike insulation material at Liquid Natural Gas (LNG) storage facilities. Using hermetically sealed glass nodules or expanded perlite aggregates and unsaturated polyester resins, a new class of lightweight polymer concretes can be manufactured. Two application procedures have been identified and shown to be feasible in laboratory studies. Precast IPC composite panels 1-in thick can be bonded to concrete substrates using epoxy gel type adhesives or mortars. Cast-in-place IPC to concrete substrates have been shown to have good bonding and insulating characteristics. Modifications of the mix design to improve the workability and sagging of the IPC for installation on vertical or sloped surfaces is necessary.

22392 **(UCID—20291) Liquefied Gaseous Fuels Spill Test Facility: facility description.** Johnson, G.W.; Thompson, D.S. (Lawrence Livermore National Lab., CA (USA)). Dec 1984. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009949.

The Liquefied Gaseous Fuels Spill Test Facility being constructed at the Department of Energy's Nevada Test Site is proposed as the basic research tool for studying the dynamics of accidental releases of various hazardous liquids. This Facility is designed to discharge, at varying discharge rates, measured volumes of liquids that have been stored under cryogenic or ambient conditions onto the surface of a dry lake bed. Performance criteria have been established on the basis of discharges normally expected from transport or storage-type accidents. Facility capabilities include means for the remote control and measurement of test spill operating parameters and for the remote, unmanned acquisition and recording of close-in and downwind gaseous concentrations and meteorological data. 5 references, 17 figures, 5 tables.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 03090022384, 22385

22393 **(UCID—20369) FEFFLAP: a finite element program for analysis of fluid-driven fracture propagation in jointed rock. Volume 2. User's manual and model verification.** Shaffer, R.J.; Ingraffea, A.R.; Heuze, F.E. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010032.

The stimulation of complex gas reservoirs is best done by massive fracturing. The fractures are driven by fluids such as gels and foams. The prediction of fracture extent requires very sophisticated models, to account for the real geologies in which induced fractures interact with natural discontinuities. We have developed a state-of-the-art model to describe fluid-driven fracture propagation in naturally jointed, gas-bearing rock formations. It is a finite element code, named FEFFLAP (Finite Element Fracture and Flow Analysis Program). The program is highly interactive, with extensive graphical displays of the fracture behavior. Many automatic features for input generation, zoning, and rezoning make the code particularly efficient. The fracture mechanics, solid mechanics and fluid mechanics are fully coupled. Model verification has been performed against analytical solutions and physical experiments. The program was developed on a CRAY computer and can be transcoded for use on workstations and minicomputers. This document constitutes the user's manual for the code and provides sample problems used for verification and demonstration of the code's versatility. 17 references, 27 figures.

0310 Legislation And Regulation

22394 **(BNL—35962) Contract carriage: a two dimensional public policy perspective.** Hurtado, A.P. (Brookhaven National Lab., Upton, NY (USA)). May 1984. Contract AC02-76CH00016. 47p. NTIS, PC A03. File Number DE85009758.

This paper provides a two dimensional model for the analysis of a contract carriage policy for the interstate natural gas pipeline industry. The two dimensions are: (1) customer flexibility and (2) transmission company operational control of the pipeline. This model suggests that public policymakers should encourage a transporation system that addresses the public's interests, and then adjust the regulatory environment to reflect this public interest perspective. 32 references, 2 figures.

0340 Combustion

22395 **(PB—85-140929/XAB) Experimental study of turbulent jet diffusion flames (revised version).** Sonju, O.K.; Hustad, J.E. (SINTEF, Trondheim (Norway)). 28 Jun 1984. 30p. (STF—15-A84048). NTIS, PC E04/MF E04.

See also PB84-109115. Sponsored by Royal Norwegian Council for Scientific and Industrial Research, Kjeller.

Experimental studies have been made on large turbulent jet diffusion flames up to heights of 8 m and heat releases of 7.5 MW. Correlations/scaling laws have been suggested on: Flame geometry, Thermal radiation fux, and Liftoff heights.

0350 Storage

22396 **(FRNC-TH—1615) Numerical solving of elastoviscoplasticity problems: application to gas storage cavities in salt deep layers.** Tijani, S.M. (Paris-6 Univ., 75 (France)). Sep 1978. 131p. (In French). NTIS (US Sales Only), PC A07. File Number DE85751010.

For the determination of stresses and deplacements in a heterogeneous structure of elastoviscoplastic materials, under a variable volumic and surfacic loading the VIPLEF program was developed. The elastic equilibrium with initial constraint is solved by the finite element method and the differential equation is integrated by the Runge-Kutta-Gill method. In the program the geometric shape is arbitrary and the material of the storage cavity is eventually heterogeneous. When experimental determination of salt rheology will be completed, the VIPLEF program will be used for the study of volume and stability of underground gas storage in salt formations.

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 04000022272

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 04040022371

22397 **(NP—5901251) Annual report of activities, October 1, 1983-September 30, 1984.** (Alabama Univ., University (USA). School of Mines and Energy Development). 1984. 27p. SOMED-Univ. of Alabama, P.O. Drawer AY, University (Tuscaloosa), AL 35486. File Number TI85901251.

Emphasis for the 1983-1984 year was directed toward enhancing the use of the more abundant fossil fuels indigenous to the state and region...coal, methane, lignite, oil shale, tar sand and peat. Of seventeen research projects identified in the MRI strategic plan for the year, twelve dealt with processing or utilization of fossil fuel minerals with principal emphasis given to coal and Alabama oil shale. The balance of the research effort was concerned with inorganic minerals processing, utilization or development.

22398 **(UCID—16986-84-4) Oil Shale Project quarterly report, October-December 1984.** Lewis, A.E. (ed.). (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010016.

Highlights of progress made during the quarter ending December, 1984 are summarized. Discussion is presented under the headings: retort modeling; toluene used in oil collection system; sulfur species in pyrolysis gas by mass spectrometry; and rate of reaction of oxidized oil shale with hydrogen sulfide. 3 figures, 2 tables. (DMC)

0405 Properties And Composition

REFER ALSO TO CITATION(S) 04050022398, 22936

22399 **(PB—85-139137/XAB) Chemical and engineering properties of Eastern oil shale. Final report.** Robl, T.L.; Koppenaal, D.W. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). Oct 1982. 316p. (IMMR—82/068). NTIS, PC A14/MF A01.

Sponsored in part by Kentucky Dept. for Natural Resources and Environmental Protection, Frankfort, and Kentucky Energy Cabinet, Lexington.

During the past few years mineral and oil companies have acquired mineral rights to oil shale in Kentucky. Research has also been initiated into the development of processes, such as the HYTORT technology and modifications of the Paraho retort, which will process these shales in an optimal fashion. A recent study sponsored by the U.S. Department of Energy concluded that an oil shale industry in Kentucky was feasible. These factors have contributed to growing interest by the public sector in the problems and potential of a Kentucky oil shale industry. This research is in part a response to this interest and is an outgrowth of discussions between personnel of the Kentucky Department of Natural Resources and Environmental Protection, the Kentucky Department of Energy, and the University of Kentucky Institute for Mining and Minerals Research. This project is designed to provide preliminary information into environmental areas, where data was lacking or insufficient. These areas included the water pollution potential, agricultural characteristics, and strength and compaction characteristics of raw and processed oil shales, overburdens, and associated soils.

22400 **Measurements of specific heat, thermal conductivity and thermal diffusivity of Utah tar sands.** Lindberg, W.R.; Christensen, R.J.; Thomas, R.R. (Department of Mechanical Engineering, University of Wyoming, Laramie, WY). *Fuel;* 64: No. 1, 80-85(Jan 1985).

A constant applied heat flux method has been used to measure the specific heat and thermal conductivity of large samples of Utah (North-west Asphalt Ridge) tar sands as a function of temperature. Independent measurements of density allowed for the calculation of thermal diffusivity. Constituent analysis of the tar sand samples also permitted the calculation of bitumen and sand specific heats. Specific heat of the bitumen was found to increase with temperature from 1.85 to 3.9 $kJkg^{-1}K^{1}91$ for temperatures between 300 and 480 K. Specific heat of the sand matrix increased only slightly, from 0.85 to 1.0 $kJ\ kg^{-1}\ K^{-1}$ for the same range of temperature. Corresponding thermal diffusivities for tar sand were found to decrease with temperature, and had a range of $5x10^{-7}$ - $9x10^{-7}m^{2}s^{-1}$ over the measured temperatures. It was concluded that the latent heat of both bitumen and water have a strong influence on the apparent overall specific heat of tar sand.

0407 Health And Safety

REFER ALSO TO CITATION(S) 04070022363

22401 **(LA—10265) Considerations for the epidemiologic study of oil shale workers.** Acquavella, J.F.; Waxweiler, R.J.; Voelz, G.L.; Wilkinson, G.S. (Los Alamos National Lab., NM (USA)). Jan 1985. Contract W-7405-ENG-36. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008908.

This report describes several epidemiological study designs that might be used to evaluate the long-term health of oil shale workers. Oil shale production involves few workers now, but growth of this industry should be anticipated. Planning for an efficient health surveillance system before the expansion occurs will help provide the necessary data to answer important health and environmental questions. A prospective cohort mortality study appears to be the best technique to study cancers other than skin cancers. Data from all oil shale facilities should be used to maximize statistical power. A list of necessary record items is presented for personal, occupational exposure, and medical data. Development of an intercompany job-title dictionary is needed to act as a surrogate index of occupational exposures. For the study of disease incidence, development of a central medical clinic data base in an area of major oil shale activity appears to be more practical than trying to operate an active worker registry over long time periods. 24 references, 7 tables.

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 04090022320

22402 **(PB—85-146405/XAB) Leaching and selected hydraulic properties of processed oil shales. Environmental research brief.** McWhorter, D.B.; Nazareth, V.A. (Colorado State Univ., Fort Collins (USA)). Oct 1984. 10p. NTIS, PC A02/MF A01.

This report describes a column leaching test procedure developed to simulate the leaching of high-volume wastes under semiarid field conditions. The report also presents results obtained when retorted oil shales (Tosco, Paraho, Lurgi) are leached by this procedure. Selected hydraulic properties are also discussed for these retorted shales including permeability and water-holding capacity.

05 NUCLEAR FUELS

0503 Mining

REFER ALSO TO CITATION(S) 05030022404, 22460

0504 Feed Processing

REFER ALSO TO CITATION(S) 05040022646

22403 (PB—85-145811/XAB) Summary of a technique for heap leach simulation on uranium ores. Open file report (final), 15 August 1977-28 August 1980. Peterson, H.D.; Seidel, D.C.; Nichols, I.L. (Colorado School of Mines, Golden (USA). Research Inst.). Apr 1984. 43p. NTIS, PC A03/MF A01.

A technique was developed for simulation of heap leaching uranium ores in 2-ft-diam columns constructed such that ores as coarse as minus 4-in could be treated in bed depths from 8 to 18 ft with test condition variations. The technique consisted of the separate steps of ore preparation, column loading, charge wetting, leaching, washing, and residue recovery. For the ores studied, sulfuric acid was found to be generally superior to alkaline lixiviants. The rate of uranium extraction by acid leaching proved to be primarily a function of percolation rate, alkalinity of the ores, and oxidant requirements of the ores. Column leaching was closely comparable to field-scale heap leaching in terms of uranium extraction rate and recovery results. Acid and oxidant requirements were lower for the field-scale operation. All column tests, as well as the field-scale heap, achieved in excess of 96-pct uranium extraction on a Bear Creek, WY, ore.

22404 (PB—85-145902/XAB) Technique for in-situ leach simulation of uranium ores. Open file report for 1 February 1979-8 Februaby 1980. Grant, D.C.; Seidel, D.C.; Nichols, I.L. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). May 1984. 66p. NTIS, PC A04/MF A01.

Prepared in cooperation with Colorado School of Mines Research Inst., Golden, CO.

In-situ uranium mining offers the advantages of minimal environmental disturbance, low capital and operating costs, and reduced mining development time. It is becoming an increasingly attractive mining method for the recovery of uranium from secondary ore deposits. To better understand the process, a laboratory technique was developed and used to study and simulate both the chemical and physical phenomena occurring in ore bodies during in-situ leaching. The simulation technique was used to determine effects of leaching variables on permeability, uranium recovery, and postleach aquifer restoration. This report describes the simulation system and testing procedure in sufficient detail to allow the construction of the system and to perform the desired leaching tests.

0505 Enrichment

REFER ALSO TO CITATION(S) 05050022466, 22989

22405 (EGG/10282—2060) Study of pulsed laser damage to optical fibers. Allison, S.W.; Gillies, G.T.; Magnuson, D.W.; Pagano, T.S. (Martin Marietta Energy Systems, Oak Ridge, TN (USA); EG and G, Inc., Goleta, CA (USA). Santa Barbara Operations). 1983. Contract AC05-84OT21400;AC08-83NV10282. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009677.

This paper describes some observations of pulsed laser damage to optical fibers with emphasis on a damage mode characterized as a linear fracture along the outer core of a fiber. Damage threshold data are presented which illustrate the effects of the focusing lens, end-surface preparation, and type of fiber. An explanation based on fiber-beam misalignment is given and is illustrated by a simple experiment and ray trace. 13 references, 8 figures, 1 table.

22406 (K—2041) Evaluation of options for reclamation and refortification of Code BG lubricating oil in the Oak Ridge Gaseous Diffusion Plant's cascade. Kirkpatrick, C.R.; Harold, N.B. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 15 Feb 1985. Contract AC05-84OT21400. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009506.

A study of reclaimed and refortified cascade lube oil at the Oak Ridge Gaseous Diffusion Plant (ORGDP) demonstrates that undesirable, used lube oil can be filtered and then refortified with proper additives to produce an oil within specified operating limits. Stability tests indicate that the oil is stable for an extended period of time. Cost analyses estimate the reclamation and refortification efforts to save ORGDP more than $1,106,200 in the K-33 building alone.

22407 (K/PS—5025) UF_6 cylinder cooling study: experimental study with a 10-ton cylinder. Park, S.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Mar 1984. Contract AC05-84OT21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009017.

Cooling data, collected from a 10-ton test cylinder after a UF_6 assay homogenization study, was analyzed. The time required for complete solidification with ambient air at 60°F average temperature was 84 hours. A numerical analysis indicated that higher film coefficients obtained by spraying water on the top half of the cylinder reduced the solidification time by 30%, but the beneficial effect of the higher film coefficient was confined to the early stages of cooling when the thickness of the solid UF_6 layer was small. The heat transfer coefficient quickly approached that of a natural convective heat transfer process as the solid layer grew. A correlation between the temperature gradient (cylinder surface to ambient air) and the complete solidification time of UF_6 inside the cylinder was developed. Hence, the completion of UF_6 solidification may be determined by observing the temperature differences between the cylinder surface and ambient air. 2 references, 11 figures, 1 table.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 05070022410, 22469

0508 Spent Fuels Reprocessing

22408 (RFP-Trans—444) Microwave-heated fluidized-bed reaction device. Odajima, Masami; Morisue, Tetsuo. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Mar 1985. Contract AC04-76DP03533. Translation of Japanese Patent No. 1984-59-4431. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009831.

The present invention relates to a microwave-heated fluidized-bed reaction device, in which a water-containing substance is irradiated with microwaves for the purpose of thermally dehydrating the substance. More specifically, the present invention concerns a microwave-heated fluidized-bed reaction device used for thermal dehydration of a large quantity of substance to be treated (e.g., uranyl nitrate solution, etc.) in a process for reprocessing spent nuclear fuels.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 05090022465, 22977, 22979, 22980, 22982

22409 (PNL-SA—12586) Simulated dry storage test of a spent PWR nuclear fuel assembly in air. Johnson, A.B. Jr.; Gilbert, E.R.; Oden, D.R.; Stidham, D.L.; Garnier, J.E.; Weeks, D.L.; Dobbins, J.C. (Pacific Northwest Labs., Richland, WA (USA); Westinghouse Electric Corp., Mercury, NV (USA)). Feb 1985. Contract AC06-76RL01830. 22p. (CONF-850314—43). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009434.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The purpose of the dry storage test was to investigate the behavior of Zircaloy-clad spent fuel in air between 200 and 275°C. Atmospheric air was used for the cover gas because of the interest in establishing regimes where air inleakage into an initially inert system would not cause potential fuel degradation. Samples of the cover gas atmosphere were extracted monthly to determine fission gas concentrations as a function of time. The oxygen concentration was monitored to detect oxygen depletion, which would signal oxidation of the fuel. The gas analyses indicated very low but detectable levels of ^{86}Kr during the first month of the test. A large increase (five orders of magnitude) in ^{85}Kr and the appearance of helium in the cover gas indicated that a fuel rod had breached during the second month of the test. Stress rupture calculations showed that the stresses and temperatures were too low to expect breaches to form in defect-free cladding. It is theorized that the breach occurred in a fuel rod weakened by an existing cladding or end cap defect. Calculations based on the rate of ^{85}Kr release suggest that the diameter of the initial breach was about 25 microns. A post-test fuel examination will be performed to locate and investigate the cause of the cladding breach and to determine if detectable fuel degradation progressed after the breach occurred. The post-test evaluation will define the consequences of a fuel rod breach occurring in an air cover gas at 270°C, followed by subsequent exposure to air at a prototypic descending temperature.

22410 **(PNL-SA—12632) Oxidation of UO_2 at 150 to 350°C.** Gilbert, E.R.; White, G.D.; Knox, C.A. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 38p. (CONF-841094—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009432.

From International workshop on irradiated fuel storage--operating experience and development programs; Toronto, Ontario, Canada (17 Oct 1984).

Tests were performed on nonirradiated UO_2 pellets from 150 to 350°C in atmospheric air and controlled environments and on spent light-water reactor (LWR) fuel fragments at 200 and 230°C in atmospheric air to determine the variables that affect oxidation behavior under dry storage conditions. The weight of spent fragments increased 50 to 100 times faster than the weight of nonirradiated UO_2 pellets at 230°C. Non-irradiated pellet fragments gained weight 5 to 7 times faster than nonirradiated pellets. The fragments simulated fuel fragmented by thermal gradients during reactor power changes. Low-density powder (U_3O_8) formed at 0.05 and 0.3% weight gain for nonirradiated pellets and fragments, respectively, but had not formed at 3% weight gain for spent fuel fragments with a burnup of 29,000 MWd/MTU. Canadian investigators had found that powder formed at intermediate levels of weight gain in CANDU spent fuel fragments with an approximate burnup of 8000 MWd/MTU. The combined effects of the high rate of weight gain in spent fuel and the burnup dependence of weight gain at powder formation resulted in a minimum in a plot of the time for the onset of powder formation versus burnup. The minimum in powder induction time occurs at or below burnup levels typical of CANDU spent fuel and spent fuel at the ends of some LWR rods. The results are described in terms of thermal and neutron irradiation-induced changes in UO_2 pellet structure and chemical composition. Other tests were performed at up to 275°C with spent fuel fragments and nonirradiated UO_2 pellets in moist nitrogen to determine the suitability of nitrogen as a cover gas. No measurable weight gain or visible physical changes occurred during the first 2 months of testing. 22 figures, 7 tables.

22411 **(PNL-SA—12658) Decay heat and heat transfer predictions for spent fuel storage systems.** Creer, J.M. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 56p. (CONF-841094—3). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009428.

From International workshop on irradiated fuel storage--operating experience and development programs; Toronto, Ontario, Canada (17 Oct 1984).

Decay heat generation rates of PWR and BWR spent fuel assemblies predicted with the ORIGEN2 computer program are presented and compared to values measured with calorimeters. Predictions are in good agreement with available experimental data. Temperatures of single assembly and multi-assembly spent fuel storage systems with both unconsolidated and consolidated fuel are predicted with the COBRA and HYDRA thermal hydraulic computer programs. Predictions are compared to limited experimental data. 9 references, 26 figures, 6 tables.

22412 **(SAND—84-2001C) Development of the Beneficial Uses Shipping System cask.** Yoshimura, H.R.; Wellman, G.W.; Moya, J.L.; Gonzales, A.; Gwinn, K.W.; Eakes, R.G.; Uncapher, W.L. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 8p. (CONF-850314—33). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009335.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The Beneficial Uses Shipping System (BUSS) cask is a Type B packaging currently under development at Sandia National Laboratories for the US Department of Energy (DOE) in their Beneficial Uses of Nuclear Waste Program. The cask will transport radioactive source capsules (CsCl and SrF_2) to facilities such as sewage and food irradiators. The principal design criteria for developing the BUSS cask are specified in 10CFR71. Extensive three-dimensional modeling and numerical analyses were performed to predict the effects of the impact, puncture, and fire accident conditions specified in the regulations. The cask prototype is being fabricated, and a Certificate of Compliance is being obtained. 16 references, 7 figures, 7 tables.

22413 **(SAND—84-2039C) Nuclear waste transportation system: cask interface and physical performance specifications.** Sanders, T.L.; Allen, G.C. Jr.; Opperman, E.K. (Sandia National Labs., Albuquerque, NM (USA); Westinghouse Hanford Co., Richland, WA (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-850314—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009339.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

This paper describes the current status and strategy for the development of civilian nuclear waste transportation cask interface and physical performance specifications. These specifications are required to support the development and evaluation of future transportation packages that will convey commercial spent fuel and other waste forms to government storage and disposal facilities in the late 1990's. 2 references, 2 figures.

22414 **(UCRL—91019) Spent fuel pin temperature PC code.** Fischer, L.E. (Lawrence Livermore National Lab., CA (USA)). 1 Mar 1985. Contract W-7405-ENG-48. 14p. (CONF-850314—30). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85008954.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

During an annual outage, a Pressurized Water Reactor (PWR) may discharge 60 or more spent fuel bundles into its storage pool. Most early PWRs were built to store 3 to 5 years of spent fuel in their pools and are beginning to exceed their capacities. One method currently being developed and licensed for expanding spent fuel storage capabilities is the dry storage of spent fuel in large casks. To reduce the probability of gross failures of fuel cladding during dry storage in casks, the fuel pin temperatures must be shown to remain within acceptable limits. LLNL has developed, for the Nuclear Regulatory Commission, a personal computer (PC) code for calculating fuel pin temperatures on the IBM PC. The code uses the Wooton-Epstein Correlation to calculate the pin temperatures and has been benchmarked against test data. An iterative type of solution is used to calculate the fuel pin temperatures for specified heat fluxes and pin configurations. The PC code is useful in performing confirmatory analyses and comparing the results with those submitted by applicants applying for storage licenses. 5 references, 2 tables.

0510 Marketing And Economics

22415 **(DOE/S—0033) Domestic uranium mining and milling industry: 1983 viability assessment.** (USDOE Energy Information Administration, Washington, DC). Dec 1984. 194p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85011094.

The domestic uranium market over the past few years has been characterized by lower-than-expected demand, falling prices, and a buildup of utility inventories well in excess of desired levels. Domestic uranium production, as a result of low market prices and high utility inventories of uranium, has also declined. Imports of low-cost uranium have accounted for an increasing share of annual domestic supply in recent years. Employment and capital investment in the uranium industry have declined, as mines and mills have slowed production, been placed on standby, or been shut down. The criteria for use in estimating the viability of the industry were promulgated by rule (10 CFR, Part 761) and published in the October 6, 1983, issue of the "Federal Register". The final rule specifies four major attributes of industry viability - resource capability, supply response capability, financial capability, and import commitment dependency. The relationships among these four attributes and the eight minimum criteria required by Section 23(b) are discussed in the final rule, which has been reproduced as Appendix A of this report. The Department of Energy's Energy Information Administration (EIA), consistent with the regulations specified in 10 CFR 761, gathered and compiled the information presented in this report on each of the four major attributes. The data and analyses in the main body of this report were based on the information available through the end of the calendar year 1983. Since the initial preparation of the report, the Secretary of Energy has requested that the Energy Information Administration incorporate the most recently available information. Appendix F provides the updated information. 35 figures, 32 tables.

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REFER ALSO TO CITATION(S) 05200022458, 22459, 22461, 22462, 22463, 22464, 22468, 22646, 22931, 23092, 23180, 23182

22416 **(BMI/ONWI—200(4)) Bibliography of studies for the Salt Repository Project Office of the Civilian Radioactive Waste Management Program, April 1978-September 1984.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jan 1985. Contract AC02-83CH10140. 309p. NTIS, PC A14. File Number DE85008734.

ONWI-200 is a bibliography of approved reports that have been produced for the US Department of Energy salt Repository Project Office of the Civilian Radioactive Waste Management Program since April 1978. This document is intended for use by the US Department of Energy, state and local officials, the US Nuclear Regulatory Commission, subcontractors to the Office of Nuclear Waste Isolation, concerned citizens, and others who need a comprehensive listing of reports related to a nuclear waste repository in salt. This document is divided into three parts. The first two list reports in sequence by their work breakdown structure. Part 1 lists salt-specific reports, and Part 2 lists generic reports. Part 3 presents the bibliographic data for the reports in Parts 1 and 2.

22417 **(BMI/ONWI—566) Hydrogeologic investigations based on drill-stem test data: Palo Duro Basin Area, Texas and New Mexico.** Bair, E.S.; O'Donnell, T.P.; Picking, L.W. (Stone and Webster Engineering Corp., Boston, MA (USA)). Feb 1985. Contract AC02-83CH10140. 184p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85009808.

Drill-stem test (DST) data were compiled from wildcat wells and DOE-sponsored wells in the Palo Duro Basin area of Texas and New Mexico. The data were used to construct pressure-depth diagrams and to map regional potentiometric surfaces, based on equivalent freshwater heads calculated from initial shut-in pressures of the Wolfcamp and Pennsylvanian brine aquifers, the two regionally important deep-basin aquifers downgradient of the proposed repository host rock. Eighty percent of the 5502 DSTs were screened from the data base containing DST data from various deep-basin geologic units because they did not comply with shut-in time and shut-in pressure agreement criteria. After screening, three sets of pressure-depth diagrams and potentiometric surfaces were constructed, corresponding to three levels of data refinement. These results indicate the possible need for more data from an areally extended study area.

22418 **(BNL-NUREG—36149) Extended storage of low-level radioactive waste: potential problem areas.** Siskind, B.; Dougherty, D.R.; MacKenzie, D.R. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-850314—55). NTIS, PC A02/MF A01 - GPO. File Number TI85009765.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

If a state or state compact does not have adequate disposal capacity for low-level radioactive waste (LLRW) by 1986 as required by the Low-Level Waste Policy Act, then extended storage of certain LLRW may be necessary. The issue of extended storage of LLRW is addressed in order to determine for the Nuclear Regulatory Commission the areas of concern and the actions recommended to resolve these concerns. The focus is on the properties and behavior of the waste form and waste container. Storage alternatives are considered in order to characterize the likely storage environments for these wastes. The areas of concern about extended storage of LLRW are grouped into two categories: 1. Behavior of the waste form and/or container during storage, e.g., radiolytic gas generation, radiation-enhanced degradation of polymeric materials, and corrosion. 2. Effects of extended storage on the properties of the waste form and/or container that are important after storage (e.g., radiation-induced oxidative embrittlement of high-density polyethylene and the weakening of steel containers resulting from corrosion by the waste). The additional information and actions required to address these concerns are discussed and, in particular, it is concluded that further information is needed on the rates of corrosion of container material by Class A wastes and on the apparent dose-rate dependence of radiolytic processes in Class B and C waste packages. Modifications to the guidance for solidified wastes and high-integrity containers in NRC's Technical Position on Waste Form are recommended. 27 references.

22419 **(CONF-850314—31) Hydrofracture operations at Oak Ridge National Laboratory.** Lasher, L.C. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009524.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The hydrofracture process (shale fracture) was developed at ORNL for the purpose of disposing of the liquid low-level radioactive waste (LLW) solutions which are generated by the research and development activities conducted at this facility. The LLW is an alkaline solution (pH $\simeq$ 10) which normally contains from 0.5 to 1.5 Ci of radioactivity per gallon. The major active constituents are ^{60}Co, ^{137}Cs, and ^{90}Sr. A pilot plant constructed in 1964 was used to develop operating techniques and evaluate equipment components. After seven successful experimental injections, this facility was converted into an operating disposal plant and was utilized in this manner from 1966 to 1980 when it was retired from service. Construction of the present disposal plant began in 1979 and was completed in October 1981. Training and shakedown operations were conducted early in 1982, and the first injection at the new site was completed in June of that year. In December 1982, after four injections had been completed, the well was inadvertently cemented in while preparing it for a sand slotting operation. A three-month recovery operation ensued. Operation of the New Hydrofracture Facility (NHF) was resumed in early April 1983, and ten injections consisting of LLW and slurried contaminated sludge have been completed without a major incident. 7 references, 9 figures, 5 tables.

22420 **(CONF-850314—42) Role of the Materials Review Board and the nuclear waste materials handbook.** Steindler, M.J.; Seefeldt, W.B. (Argonne National Lab., IL (USA)). 24 Mar 1985. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009720.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The US Department of Energy has established an organizational structure that assures the quality of key data identified as being important to the licensing of a nuclear waste repository by the US Nuclear Regulatory Commission. The Materials Characterization Center collects and/or develops the test methods needed to

obtain the data, and acts as a clearinghouse for all data obtained by the methods, regardless of source. The Materials Review Board reviews both test methods and test data submitted to it, and approves them if they meet the rigorous criteria and standards that have been established. The appearance of test methods and test data in the Nuclear Waste Materials Handbook is evidence that the material has undergone intensive review and can be used with confidence within the bounds of the application specified. The principal use of the Handbook is in the repository licensing process.

22421 **(DOE/CH—1) Region-to-area screening methodology for the Crystalline Repository Project.** (Battelle Memorial Inst., Argonne, IL (USA). Office of Crystalline Repository Development). Apr 1985. Contract AC02-83CH10139. 422p. NTIS, PC A18/MF A01; GPO Dep. File Number DE85009892.

The purpose of this document is to describe the Crystalline Repository Project's (CRP) process for region-to-area screening of exposed and near-surface crystalline rock bodies in the three regions of the conterminous United States where crystalline rock is being evaluated as a potential host for the second nuclear waste repository (i.e., in the North Central, Northeastern, and Southeastern Regions). This document indicates how the US Department of Energy's (DOE) General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories (10 CFR 960) were used to select and apply factors and variables for the region-to-area screening, explains how these factors and variable are to be applied in the region-to-area screening, and indicates how this methodology relates to the decision process leading to the selection of candidate areas. A brief general discussion of the screening process from the national survey through area screening and site recommendation is presented. This discussion sets the scene for detailed discussions which follow concerning the region-to-area screening process, the guidance provided by the DOE Siting Guidelines for establishing disqualifying factors and variables for screening, and application of the disqualifying factors and variables in the screening process. This document is complementary to the regional geologic and environmental characterization reports to be issued in the summer of 1985 as final documents. These reports will contain the geologic and environmental data base that will be used in conjunction with the methodology to conduct region-to-area screening.

22422 **(DOE/CH—10(1)) Identification of sites within the Palo Duro Basin. Volume 1. Palo Duro Location A.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1984. Contract AC02-83CH10140. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85006286.

This three-volume document narrows to two sites for continued investigations for potential nuclear waste repository sites in the Palo Duro Basin of the Texas Panhandle. Volume 1 narrows a site previously identified in Deaf Smith County, Texas; Volume 2 narrows a site previously identified in Swisher County, Texas; and Volume 3 contains responses to comments received regarding the drafts of Volumes 1 and 2 (BMI/ONWI-531). These volumes discuss the methodology and logic used as well as the results that narrowed these sites. Each of the 10 site performance criteria was divided into descriptors related to site performance characteristics. Each descriptor was evaluated by a systematic logic to determine if it could be used as a discriminator. Then more- and less-preferred areas for groups of discriminators were defined and composite maps were prepared and evaluated to identify the sites.

22423 **(DOE/CH—10(2)) Identification of sites within the Palo Duro Basin. Volume 2. Palo Duro Location B.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1984. Contract AC02-83CH10140. 171p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85006285.

This three-volume document narrows to two sites for continued investigations for potential nuclear waste repository sites in the Palo Duro Basin of the Texas Panhandle. Volume 1 narrows a site previouly identified in Deaf Smith County, Texas; Volume 2 narrows a site previously identified in Swisher County, Texas; and Volume 3 contains responses to comments received regarding the drafts of Volumes 1 and 2 (BMI/ONWI-531). These volumes discuss the methodology and logic used as well as the results that narrowed these sites. Each of the 10 site performance criteria was divided into descriptors related to site performance characteristics. Each descriptor was evaluated by a systematic logic to determine if it could be used as a discriminator. Then more- and less-preferred areas for groups of discriminators were defined and composite maps were prepared and evaluated to identify the sites.

22424 **(DOE/TIC—3392-Suppl.1) Radioactive waste management: a series of bibliographies. Formerly utilized sites: remedial action. Supplement 1.** McLaren, L.H. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Apr 1985. 43p. NTIS, PC $8.50/MF A01; GPO Dep. File Number DE85008190.

This bibliography contains information on formerly utilized sites included in the Department of Energy's Energy Data Base from November 1982 through December 1983. The abstracts are grouped by subject category as shown in the table of contents. Entries in the subject index also facilitate access by subject, e.g., Abandoned Sites/Decontamination. Within each category the arrangement is by report number for reports, followed by nonreports in reverse chronological order. These citations are to research reports, journal articles, books, patents, theses, and conference papers from worldwide sources. Five indexes, each preceded by a brief description, are provided: Corporate Author, Personal Author, Subject, Contract Number, and Report Number.

22425 **(DP-MS—84-122) Leaching behavior of nuclear waste glass heterogeneities.** Zhu, B.F.; Clark, D.E.; Hench, L.L.; Wicks, G.G. (Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 26p. (CONF-850536—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003659.

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

The results of a six-month burial experiment in granite are discussed. An alkali borosilicate simulated nuclear waste glass was buried in 3⁻m boreholes at the 345⁻m level in the Stripa mine. Some glass specimens containing crystallites exhibit preferential attack of the interface between crystalline and glassy phases. The crystalline phase, identified as spinel solid solution, exhibits better chemical resistance than the glassy phase. Results obtained from homogeneous and heterogeneous glasses (i.e., those containing a crystalline phase) are compared. 23 references, 7 figures, 2 tables.

22426 **(DP-MS—84-127) Flow measurement and control in the defense waste process.** Heckendorn, F.M. II. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 14p. (CONF-850582—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005860.

From 31. ISA international instrumentation symposium; San Diego, CA, USA (6 May 1985).

The Defense Waste Processing Facility (DWPF) for immobilizing Savannah River Plant (SRP) high-level radioactive waste is now under construction. Previously stored waste is retrieved and processed into a glass matrix for permanent storage. The equipment operates in an entirely remote environment for both processing and maintenance due to the highly radioactive nature of the waste. A fine powdered glass frit is mixed with the waste prior to its introduction as a slurry into an electric glass furnace. The slurry is Bingham plastic in nature and of high viscosity. This combination of factors has created significant problems in flow measurement and control. Specialized pieces of equipment have been demonstrated that will function properly in a highly abrasive environment while receiving no maintenance during their lifetime. Included are flow meters, flow control technology, flow switching, and remote connections. No plastics or elastomers are allowed in contact with fluids and all electronic components are mounted remotely. Both two- and three-way valves are used. Maintenance is by crane replacement of process sections, utilizing specialized connectors. All portions of the above are now operating full scale (radioactively cold) at the test facility at SRP. 4 references, 8 figures.

22427 **(DPST—84-649) DWPF melter feed system testing.** Steidlitz, R.K.; Grimm, D.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 21 Aug 1984. Contract AC09-76SR00001. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009486.

The recirculation loop feed system (RLFS) was tested at the ETF over a ten-month period to demonstrate its performance for the DWPF melter feed system. Results indicate that flow can be maintained in the DWPF basic data range of 0.4 to 0.7 gpm over the full range of DWPF slurry rheologies. In addition, wear characteristics of all major system components including pump, piping, and restrictors are adequate for the goal wear life of 4000 hours (1/2 year). Automatic flow control could not be demonstrated initially because of equipment problems, and then later because of high pump vibration caused by large debris trapped in the impeller. The RLFS is recommended as the reference melter feed system provided that adequate automatic flow control is demonstrated further in melter feed systems.

22428 **(DPST—85-263) Investigations of slope stability, Savannah River Plant, Aiken, South Carolina. Draft report.** (Woodward-Clyde Consultants, Plymouth Meeting, PA (USA)). [1985]. Contract AC09-76SR00001. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010062.

Our analysis of slope stability indicates acceptable factors of safety for trenches excavated at a slope inclination of one (horizontal) to one (vertical). Further, without the addition of externally applied loads, such as construction trafficking and the gantry crane, a slope inclination of 0.75 horizontal to 1.0 vertical was found to have an acceptable factor of safety of 1.5. Setback distances were calculated for a slope inclination of one to one, and it was found that the gantry crane loading could safely be applied at a setback distance of approximately 7.5 feet while maintaining a factor of safety of approximately 1.2. Similarly, setback distances required for dump trucks and scrapers would be expected to be approximately 6 feet and 10 feet, respectively, to maintain a factor of safety of 1.2. In order to allow flexibility with construction loadings, parametric studies were utilized for construction trafficking to enable setback distances to be selected consistent with actual equipment to be utilized during construction. The effect of removal of surficial soils was investigated, and it is concluded that a minimum of 4-1/2 feet should be removed from all areas prior to the excavation of slopes.

22429 **(DPST—85-264) Boring and instrument installation DWPF salt disposal site.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [1985]. Contract AC09-76SR00001. 42p. NTIS, PC A03. File Number DE85009489.

This report provides the geologic data, the installation details of piezometers, and the laboratory testing results necessary to achieve the following objectives: (1) to produce accurate geologic information by careful sampling of the geologic materials penetrated; and (2) to create permanent facilities for monitoring water levels and for making future selected hydrologic tests.

22430 **(DPST—85-265) Parametric modeling for design of a waste disposal facility.** (INTERA Technologies, Inc., Houston, TX (USA)). 31 Dec 1982. Contract AC09-76SR00001. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009487.

The disposal of chemical wastes to an engineered environment within the unsaturated zone is a commonly used landfill practice. For the Savannah River Plant (SRP) operated by E.I. du Pont de Nemours and Company for the US Department of Energy, it is proposed that selected wastes be place in designed landfill trenches on the plant site. To meet drinking water standards in the underlying groundwater, a series of barriers to leachate migration have been considered. These include locating the saltcrete trenches in the zone of aeration above the water table, the low permeability of the saltcrete itself, along with low permeability liners surrounding the saltcrete monoliths, and the so-called wick-effect. Before undertaking construction of such a facility, DuPont requested INTERA Environmental Consultants to undertake a quantitative study to evaluate various designs and design parameters, in order to insure that drinking water standards will be met. The study described in this report uses a computer simulation code to provide such a quantification for a number of different designs. 10 references, 17 figures, 8 tables.

22431 **(EGG—02184) Metallographic examination of EPICOR-II liners from Three Mile Island.** McConnell, J.W. Jr.; Spaletta, H.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 7p. (CONF-850314—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008651.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Materials from selected EPICOR-II prefilter liners were collected and examined as part of the EPICOR and Waste Research and Disposition Program sponsored by the Department of Energy at the Idaho National Engineering Laboratory (INEL). The intent of that examination was to define the internal condition of liners and ensure that liners could be stored at INEL for ten years. This paper discusses the liner-integrity examination and presents the results of these examinations. Metallurgical examination of sections removed from the liners revealed no evidence of pitting or pitting-type corrosion. Measurements of wall thickness indicate that material was missing from the wall of PF-3 in an area where the protective coating had been removed to form a conductivity patch. If it is assumed that all thinning of the wall in that area is caused by corrosion, the liners will have a lifetime of approximately 50 years. 12 figures.

22432 **(EGG-EA—6797) Technology assessment for INEL buried TRU waste management alternatives.** Henjum, K.A.; Hallinan, E.J.; Hendrickson, P.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1985. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008041.

The leave-as-is option is used at present for buried TRU waste at the INEL. The environmental monitoring program and subsurface migration studies will help to determine the adequacy of this alternative as a long-term management method. In any case, no new technology is contemplated, other than the gradual upgrading in monitoring and maintenance procedures and the SDA stabilization project as long as institution control of the INEL is maintained by the DOE. Improved confinement methods such as engineered barriers, grouting, and in situ vitrification, have been tested at other locations. The two latter methods will be demonstrated at the INEL. These methods are still developing and have not yet been tested at full scale. Subsurface mapping, to pinpoint waste locations, is a developing technology which would be useful in both improved confinement and retrieval operations. Ground-penetrating radar and magnetometry are two mapping techniques. The equipment, buildings, and personnel protection required for retrieval operations are available commercially and will need little or no modification for retrieval purposes. The Stored Waste Examination Pilot Plant (SWEPP) is designed to demonstrate the effectiveness of the certification, nondestructive examination, and TRU assay processes on stored TRU waste. SWEPP will be operable by the end of FY-1985. Minor technology development is expected to be needed for SWEPP to certify buried waste after retrieval and soil separation. Stored TRU waste processing at the Process Experimental Pilot Plant (PREPP) is scheduled to begin in FY-1987. Some modifications in the design of the plant would be necessary prior to processing buried TRU waste. Soil-immobilization processes are fully developed in other industries. These methods need to be tested on INEL soil to determine the most effective process. Soil-decontamination methods are still developing.

22433 **(EGG-M—02084) Degradation of resins in EPICOR-II prefilters from Three Mile Island.** McConnell, J.W. Jr.; Sanders, R.D. Sr. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 8p. (CONF-850314—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008582.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The Low-Level Waste Data Base Development - EPICOR-II Resin/Liner Investigation Project funded by the US Nuclear Regulatory Commission is examining the chemical and physical

conditions of the synthetic ion exchange resins found in several EPICOR-II prefilters PF-8 and -20. Results are compared with baseline data from tests performed on unirradiated EPICOR resins to determine if degradation has occurred due to the high internal dose received by the resins.

22434 **(EGG-M—08785) Radioactive waste examination pilot plant.** Van Siclen, V.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 4p. (CONF-8506107—1). NTIS, PC A02. File Number DE85009878.

From Society of Women Engineers conference; Minneapolis, MN, USA (27 Jun 1985).

The Stored Waste Examination Pilot Plant (SWEPP) is a contact-handled radioactive waste examination pilot facility at the Department of Energy's Idaho National Engineering Laboratory. The plant determines through computerized nondestructive examination (NDE) whether transuranic waste now stored at the INEL qualifies for shipment to DOE's Waste Isolation Pilot Plant in New Mexico or whether it needs further processing. As a container proceeds through the plant it is weighed, x-rayed with real-time radiography to determine actual contents, assayed to determine fissile contents, ultrasonically examined to determine container integrity, and surveyed for surface radiation and contamination. Because the facility handles transuranic waste, proper information management is essential. A microprocessor-based data management system has been developed for this purpose; a key feature is its direct communication with the computerized NDE equipment and with a mainframe computer on which the data is stored permanently. 4 references, 2 figures.

22435 **(EGG-M—21284) Experiences in development, qualification, and use of concrete high-integrity containers in commercial disposal of radioactive wastes.** Schmitt, R.C.; Reno, H.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 4p. (CONF-850314—25). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008648.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Disposal of EPICOR prefilters as commercial radioactive wastes is being accomplished by using a first-of-a-kind, reinforced concrete, high-integrity container in lieu of prior in situ solidification of resins before disposal of prefilters. Experiences in developing, testing, certifying, and using high-integrity containers are an untold story worthy of review for the benefit of the nuclear industry at large. The lessons learned in gaining regulatory acceptance of the concrete HIC are discussed.

22436 **(EGG-PBS—6731) Technical evaluation of Aerojet Energy Conversion Company's topical report on a mobile volume reduction system.** Henscheid, J.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 25 Oct 1984. Contract AC07-76ID01570. 17p. NTIS, PC A02/MF A01 - GPO. File Number TI85009920.

This report summarizes EG and G Idaho's review of Aerojet Energy Conversion Company's (AECC's) topical report on a Mobile Volume Reduction System. The review evaluated compliance with pertinent codes, standards and regulations. The initial review was discussed with AECC by EG and G Idaho and the NRC, and all outstanding issues resolved before this final evaluation was made.

22437 **(ESG-DOE—13507) Interim Storage Facility decommissioning. Final report.** Johnson, R.P.; Speed, D.L. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 15 Mar 1985. Contract AT03-82SF11669. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008686.

Decontamination and decommissioning of the Interim Storage Facility were completed. Activities included performing a detailed radiation survey of the facility, removing surface and imbedded contamination, excavating and removing the fuel storage cells, restoring the site to natural conditions, and shipping waste to Hanford, Washington, for burial. The project was accomplished on schedule and 30% under budget with no measurable exposure to decommissioning personnel.

22438 **(GJ/TMC—18) Operating manual for the radon-daughter chamber.** Langner, G.H. Jr.; Nelson, T. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jan 1985. Contract AC07-76GJ01664. 97p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85008474.

A radon-daughter chamber was constructed at the US Department of Energy (DOE) Grand Junction Projects Office (GJPO) facility for the purpose of calibrating, testing and evaluating radon and radon-daughter measuring instruments used in support of DOE remedial action programs. The chamber is an environmentally controlled cylindrical vessel through which air containing radon can be circulated. Environmental parameters within the chamber and their respective controllable ranges include radon concentration (1 to 1000 pCi/l), ventilation rate (0.25 to 10 air changes per hour), temperature (0 to 45°C), dew point (-10°C to saturated), and condensation-nuclei concentration (10 to $10^4/cm^3$).

22439 **(LA-UR—85-785) Equilibrium sorption of cobalt, cesium, and strontium on Bandelier Tuff: analysis of alternative mathematical modeling.** Polzer, W.L.; Fuentes, H.R.; Essington, E.H.; Roensch, F.R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 8p. (CONF-850314—41). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009570.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Sorption isotherms are derived from batch equilibrium data for cobalt, cesium and strontium on Bandelier Tuff. Experiments were conducted at an average temperature of 23°C and equilibrium was defined at 48 hours. The solute concentrations ranged from 0 to 500 mg/L. The radioactive isotopes ^{60}Co, ^{137}Cs, and ^{85}Sr were used to trace the sorption of the stable solutes. The Linear, Langmuir, Freundlich and a Modified Freundlich isotherm equations are evaluated. The Modified Freundlich isotherm equation is validated as a preferred general mathematical tool for representing the sorption of the three solutes. The empirical constants derived from the Modified Freundlich isotherm equation indicate that under dynamic flow conditions strontium will move most rapidly and cobalt least rapidly. On the other hand, chemical dispersion will be greatest for cesium and least for strontium. Hill Plots of the sorption data suggest that in the region of low saturation sorption of all three solutes is impeded by interactions among sorption sites; cobalt exhibits the greatest effect of interactions and strontium shows only a minimal effect. In the saturation region of 50% or more, sorption of cobalt is enhanced slightly by interactions among sorption sites whereas sorption of cesium and strontium appears to be independent of site interactions. 9 references, 4 figures, 2 tables.

22440 **(NMERDI—2-69-1112-Vol.1) Geomorphic criteria for selecting stable uranium tailings disposal sites in New Mexico. Volume 1. Technical report. Final report.** Wells, S.G.; Gardner, T.W. (New Mexico Univ., Albuquerque (USA). Dept. of Geology; Pennsylvania State Univ., University Park (USA). Dept. of Geosciences). Mar 1985. 374p. NMERDI-Univ. of New Mexico, Suite M 457 Washington SE, Albuquerque, NM 87108. File Number TI85901171.

Essential to the disposal of uranium mill tailings in northwestern New Mexico is the geomorphic stability of the disposal site. Geomorphic stability assessment involves 3 steps: (1) evaluating the site's past geomorphic stability by determining the age of the landscape and its associated deposits; (2) quantifying short- and long-term geomorphic processes operating in the site area; and (3) evaluating the impact of mining activity and reclamation on the geomorphic stability of the site area. A heirarchy of geomorphic hazards which might impact a site area include: (1) drainage network extension/channel headcutting, (2) piping and gullying, (3) bank erosion and meander growth, (4) drainage network and channel incision, (5) channel aggradation, and (6) valley floor deposition and wind erosion. All of these processes operate on a scale of meters of change per year over historic time periods. Landscapes which have undergone significant changes in historic and Holocene time periods are valley floors. Valley floors are considered one of the most unstable landscapes for siting of uranium mill tailings.

22441 **(NMERDI—2-69-1112-Vol.2) Geomorphic criteria for selecting stable uranium tailings disposal sites in New Mexico. Volume 2. Appendices. Final report.** Wells, S.G.; Gardner, T.W. (New Mexico Univ., Albuquerque (USA). Dept. of Geology; Pennsylvania State Univ., University Park (USA). Dept. of Geosciences). Mar 1985. 91p. NMERDI-Univ. of New Mexico, Suite M 457 Washington SE, Albuquerque, NM 87108. File Number TI85901279.

22442 **(NUREG/CR—4061) Leachate plume migration downgradient from uranium tailings disposal in mine stopes.** Nelson, R.W.; McKeon, T.J.; Conbere, W. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 80p. (PNL—5318). NTIS, PC E02/MF A01 - GPO $5.50. File Number TI85009618.

Includes 1 sheet of 48x reduction microfiche.

A method previously developed at Pacific Northwest Laboratory has been simplified and extended to better evaluate the environmental consequences of below-water-table disposal of uranium mill tailings in mine stopes. The method described uses analytical expressions for the velocity potential and examines numerically the convective transport of tailings liquor and leachate through the aquifer and into a water supply well located downgradient from the mine stope. The overall dependence of the leachate plume size and shape on the hydrologic parameters and the tailings disposal geometry are presented in graphical form for use in preliminary assessments. The graphical results are also used to set up worst-case scenarios for return of the leachate constituents to the biosphere via the pumped water supply well. The interactive computer models developed to evaluate such worst-case conditions are presented, discussed, and used to evaluate four typical situations. 4 references, 16 figures, 1 table.

22443 **(NUREG/CR—4174) Rock mass sealing: experimental assessment of borehole plug performance. Annual report, June 1983-May 1984.** Daemen, J.J.K.; Greer, W.B.; Adisoma, G.S.; Fuenkajorn, K.; Sawyer, W.D. Jr.; Yazdandoost, A.; Akgun, H.; Kousari, B. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Mar 1985. 383p. NTIS, PC A17/MF A01 - GPO. File Number TI85901304.

This report describes experimental field and laboratory borehole plugging performance assessment studies that have been performed, completed, started, or planned during the period June 1, 1983-May 31, 1984. Results are given from field flow tests on three cement plugs installed in vertical boreholes in basalt and on one nearly horizontal cement plug. The horizontal plus seals the borehole very well, as does one of the vertical plugs. The initial hydraulic conductivity of the other two vertical field plugs has been relatively high, and remedial action is described. Laboratory simulations have been performed to study the influence of dynamic loading on cement plug performance, and no detrimental effects have been detected. Conversely, drying of cement plugs, especially over extended periods of time and at elevated temperatures does increase the hydraulic conductivity of the plugs severely, as well as reducing their bond strength along the plug-rock interface. Microscopic inspection, strength and flow tests on boreholes in basalt have been used to identify the characteristics of a drilling-induced damaged zone in basalt. While such a damaged zone exists, and has typical features (e.g., fracture density, size, location, orientation) determined by the drilling method and the rock characteristics, it is thin and not likely to be a preferential flowpath. A comprehensive suite of standard engineering characterization tests has been performed on seven commercial bentonites, complemented by flow tests on bentonite plugs, chemical analysis and swelling tests. Experimental designs are given for the study of size and of thermal effects on plug performance, and a few preliminary results are presented. Results are included from ongoing cement push-out tests and swelling measurements.

22444 **(ONWI—118-Vol.2) Gulf Coast Salt Domes geologic Area Characterization Report, East Texas Study Area. Volume II. Technical report.** (Law Engineering Testing Co., Marietta, GA (USA)). Jul 1982. Contract AC06-76RL01830. 352p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85005407.

The East Texas Area Characterization Report (ACR) is a compilation of data gathered during the Area Characterization phase of the Department of Energy's National Waste Terminal Storage program in salt. The characterization of Gulf Coast Salt Domes as a potential site for storage of nuclear waste is an ongoing process. This report summarizes investigations covering an area of approximately 2590 km^2 (1000 mi^2). Data on Oakwood, Keechi, and Palestine Domes are given. Subsequent phases of the program will focus on smaller land areas and fewer specific salt domes, with progressively more detailed investigations, possibly culminating with a license application to the Nuclear Regulatory Commission. The data in this report are a result of drilling and sampling, geophysical and geologic field work, and intensive literature review. The ACR contains text discussing data usage, interpretations, results and conclusions based on available geologic and hydrologic data, and figures including diagrams showing data point locations, geologic and hydrologic maps, geologic cross sections, and other geologic and hydrologic information. An appendix contains raw data gathered during this phase of the project and used in the preparation of these reports.

22445 **(PNL—5237) Verification and benchmarking of MAGNUM-2D: a finite element computer code for flow and heat transfer in fractured porous media.** Eyler, L.L.; Budden, M.J. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 119p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85009792.

The objective of this work is to assess prediction capabilities and features of the MAGNUM-2D computer code in relation to its intended use in the Basalt Waste Isolation Project (BWIP). This objective is accomplished through a code verification and benchmarking task. Results are documented which support correctness of prediction capabilities in areas of intended model application. 10 references, 43 figures, 11 tables.

22446 **(PNL-SA—12571) Instrumentation concepts for nuclear waste glass melters.** Barnes, S.M.; Wise, B.M.; Westsik, J.H.; Jr. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 6p. (CONF-850314—38). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009430.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Several instrumentation concepts are being developed at the Pacific Northwest Laboratory (PNL) for process control of high-level waste glass melters. These systems include an infrared imaging system, a glass level monitor, a feed crust stability sensor, and in-melter thermocouple arrays. These instrumentation systems provide redundant indications of the melter operating status and can detect potential process upset conditions such as glass foam and high feed rates. The systems are designed to withstand the melter operating environment of high temperatures and radiation levels, and corrosive gases and slurry. 5 references, 9 figures.

22447 **(PNL-SA—12614) Reference materials for nuclear waste investigation.** Daniel, J.L.; Mellinger, G.B.; Barner, J.O. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 8p. (CONF-850314—39). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009316.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

A primary ingredient for success of any systematic investigation utilizing well defined test programs is the availability of high quality well characterized test materials representative of the product and conditions under investigation. The Materials Characterization Center at Pacific Northwest Laboratory (PNL) has responsibility for the formulation, acquisition, characterization and distribution of reference and testing materials suitable foe common use in US nuclear waste repository development programs. The materials now available from MCC for this purpose have been obtained either by production in PNL laboratory, by acquisition of existing well-documented material, or by special order to glass industry specialists. Intensive characterization of these materials has been conducted for MCC in analytical laboratories of PNL and at National Bureau of Standards (NBS), Schott Optical Co., Westinghouse-

Hanford, EG and G Idaho, and/or EXXON Nuclear Idaho. Statistical methods are being utilized in designing sampling procedures and evaluating analytical data for the characterization. These standard materials are currently available in two classifications: (1) Approved Reference Materials (ARMs) are to be used for test reference and calibration, similar to the SRMs of NBS. (2) Approved Testing Materials (ARMs) include specific waste of two types, waste glass and spent fuel. ARM1 is available in reasonable quantity upon request and without charge. The other radioactive reference and testing materials are available to authorized investigators. These materials normally are provided in the form in which they were produced, e.g., glass as cast bars. Inquiries should be directed to the MCC at PNL.

22448 **(RFP—3680-Draft) Remote-handled/special case TRU waste characterization summary.** Detamore, J.A. (Rockwell International Corp., Golden, CO (USA). Transuranic Waste Systems Office). 27 Feb 1984. Contract AC04-76DP03533. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004978.

Remote-handled wastes are stored at Los Alamos, Hanford, Oak Ridge, and the Idaho National Engineering Laboratory. The following will be a site by site discussion of RH waste handling, placement, and container data. This will be followed by a series of data tables that were compiled in the TRU Waste Systems Office. These tables are a compendium of data that is the most up to date and accurate data available today. 2 figures, 10 tables.

22449 **(RHO-BW-SA—355-P) Basalt Waste Isolation Project: status and issues.** Ash, E.B. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1984. Contract AC06-77RL01030. 30p. (CONF-840455—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE85009692.

From Atomic Industrial Forum fuel cycle '84; Atlanta, GA, USA (1 Apr 1984).

Preliminary site studies to support site screening began at the Hanford Site in southeastern Washington in 1976 and have continued since that time. Two full-scale heater tests, simulating the heat output from waste packages, were conducted to measure the effect of thermal loading on the basalt rock. In the tests, basalt temperature was taken up to 1200°F without failure. Data from boreholes will help establish a conceptual model of the local and regional groundwater flow system. Pumping tests are planned to determine the hydraulic properties of the basalt, such as vertical and horizontal conductivities and the storage coefficient over a large (several square mile) area. The conceptual design of the waste package is complete. Preliminary irradiation corrosion tests, which measure the manner and rate of canister material corrosion in contact with basalt groundwater, have been completed. Thermal stability tests on the backfill material have also been performed.

22450 **(SAND—83-7089) Conceptual engineering studies and design for three different machines for nuclear waste transporting, emplacement, and retrieval.** Fisk, A.T.; de Bakker, P.; Doherty, B.J.; Pokorski, J.P.; Spector, J. (Foster-Miller, Inc., Waltham, MA (USA)). Mar 1985. Contract AC04-76DP00789. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009995.

This report covers conceptual engineering studies and design of machinery for transporting canisters containing spent fuel elements, high-level waste, and cladding waste, and emplacing and retrieving them from long (up to 600 ft), horizontal boreholes in the tuff formations of Yucca Mountain, Nevada. Included in the discussion are cask concepts, two waste transporter designs, two emplacement mechanism designs, normal and adverse retrieval, overall scenarios for transporting, emplacing, and retrieving waste, and safety and cost analyses. Also presented is the rationale used in all the decisions that were made. 7 references, 90 figures, 26 tables.

22451 **(SAND—84-0910) Repository sealing plan for the Nevada Nuclear Waste Storage Investigations Project, fiscal years 1984 through 1990.** Fernandez, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 161p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85010414.

This report presents a plan to develop acceptable sealing methods for a prospective nuclear waste repository in unsaturated tuff in Yucca Mountain, which is on and adjacent to the Nevada Test Site. Sealing is the permanent closure of the underground facility, shafts, ramps, and boreholes. Questiona associated with the performance of the sealing system form the basis for this plan. Tasks that contribute to the resolution of these questions and support the documentation required for the construction authorization application are proposed. The approach to answering the performance-related questions is divided into six steps: (1) assess the need for sealing, (2) define the design requirements, (3) measure the material properties, (4) assess the performance of sealing designs, (5) perform laboratory analyses and field testing, and (6) reassess the performance of sealing designs. Organization of the tasks supporting each step is illustrated by detailed work-flow diagrams.

22452 **(SAND—84-1958C) Facilities for a repository in tuff: a design compatible with the Yucca Mountain site.** MacDougall, H.R.; Norman, N.A. (Sandia National Labs., Albuquerque, NM (USA); Bechtel National, Inc., San Francisco, CA (USA)). 1985. Contract AC04-76DP00789. 14p. (CONF-850314—47). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010069.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

This paper delineates some of the major relevant characteristics of the candidate site for a radioactive-waste repository at Yucca Mountain, Nevada, that must be addressed in the conceptual design of surface and subsurface facilities.

22453 **(UCRL—53574) Reaction of the Topopah Spring Tuff with J-13 water at 120°C.** Oversby, V.M. (Lawrence Livermore National Lab., CA (USA)). 18 Jul 1984. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009948.

This report describes a series of hydrothermal experiments using crushed tuff from the Topopah Spring Member and natural ground water from well J-13. The purpose of these experiments is to define the changes in water chemistry that would result from temperature changes caused by emplacing high-level nuclear waste in a repository in the Topopah Spring tuff. Experiments were conducted at 120°C in Teflon-lined reaction vessels at four separate rock-to-water ratios and for reaction times up to 72 days. The composition of evaporite deposits contained in the pores of the surface-outcrop rock material used in these experiments is determined from solution compositions resulting from treatment of the rock before the start of the experiments. Results from the experiments at 120°C are compared with previous experimental results from hydrothermal reaction of the Topopah Spring tuff with J-13 water at 90 and 150°C. The main conclusion that can be drawn from this work is that changes in the water chemistry due to heating of the rock-water system can be expected to be very minor. There is no significant source of anions (F^-, Cl^-, NO_3^-, or SO_4^{2-}) in the rock; solution anion compositions after reaction of pretreated rock with J-13 water differ very little from the starting compositions. The major changes in cations are an increase in silica to approximately the level of cristobalite solubility, supersaturation of aluminum followed by slow precipitation, and fairly rapid precipitation of calcium and magnesium due to the retrograde solubility of calcite. These results are in good agreement with those previously reported for reaction of the tuff with J-13 water at 90 and 150°C. 7 references, 7 figures, 28 tables.

22454 **(USGS-OFR—83-133) Hydrogeologic investigation of the Maxey Flats radioactive waste burial site, Fleming County, Kentucky.** Zehner, H.H. (Geological Survey, Louisville, KY (USA). Water Resources Div.). 1983. 177p. US Geological Survey, Box 25425, Federal Center, Denver, CO 80225. File Number TI85901184.

Part of a hilltop named Maxey Flats was used as a commercial radioactive waste burial site from 1963 to 1977. The hill is about 9 miles from the city of Morehead. The climate of the area is humid, with normal annual precipitation 44.30 in. for the period 1941 through 1970. Most of the 47 burial trenches on the site are completed in weathered shale. They are covered with clay and crushed shale, but water infiltrates the covers and accumulates in

the waste. The contaminated trench water is later removed and evaporated. Assuming water in trenches would not overflow onto the ground surface, flow through fractured rocks would be the principal means of contaminated-water transport if trench water were to move from the burial site. The bases of most trenches consist of a 1.5-ft-thick sandstone bed, at a depth of about 25 ft below ground level. Radionuclides have moved laterally through fractures in the bed as much as 270 feet from the nearest burial trench. Rocks underlying the burial site are of Mississippian, Devonian, and Silurian age, about 80% of which are shale. The bedrock has poor water-transmitting capability, and virtually all flow is through fractures. The spacing between most fractures is several feet, although it ranges from a few inches to more than 100 ft. Most fractures terminate, or are offset, at bedding planes. The ground-water system is therefore very nonuniform, and more permeable in the horizontal direction. At least eight hydrologic units underlie the burial site.

22455 **(DOE/TIC—3311-S13-Pts.1and2) Radioactive waste processing and disposal: a bibliography. Part 1. Abstracts; Part 2. Indexes.** McLaren, L.H. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Mar 1985. 572p. NTIS, PC $41.00/MF A01; GPO Dep. File Number DE84013531.

This compilation contains 4567 citations to foreign and domestic research reports, journal articles, patents, conference proceedings, and books dealing with radioactive waste management. These citations were added to the DOE Energy Data Base from January 1983 through December 1983. Five indexes are included: Corporate Author, Personal Author, Subject, Contract Number, and Report Number.

22456 **(WINDSCALE-TRANS—994) Notes on incineration of radioactive waste.** Martin, L.M. Translated from *Energia Nuclear (Madrid) ;* **28**: No. 148, vp(Mar-Apr 1984). 15p. NTIS (US Sales Only), MF A01. File Number DE85901190. DE85901190

The problem of finding commercial sites for the disposal of low-level radioactive waste and temporary storage of residues containing transuranic elements has led to research on using a method to reduce the volume of the waste originating from nuclear installations. The following incineration processes are discussed: acid digestion process, controlled air incineration, fluid bed incineration, centrifugal incineration (cyclone), electrofusion, revolving furnace and simple kiln incineration, and pyrolysis of ashes. An appendix is included that deals with incineration of waste from bio-medical institutions. 5 figures.

22457 **(BNL-tr—1040) Dehydration of contaminated animals using a commerical lyophilizer.** Suda, Hirofumi; Ishige, Kazuto; Yokota, Shigeaki; Fujita, Hitoshi; Mori, Tomoyuki. Translated from *Radioisotopes (Tokyo) ;* **28**: No. 5, 319-321(May 1979). Contract AC02-76CH00016. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85006915. DE85006915

The paper reports results of experiments conducted to determine the feasibility of dehydrating contaminated laboratory animals using a commercial lyophilizer. The dehydration rates of rats and mice injected with tritium and carbon 14 were measured for both laparotomized and whole animals. 6 references, 3 figures, 2 tables. (ACR)

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REFER ALSO TO CITATION(S) 05300022422, 22423, 22430, 22439, 22442, 22445, 22453, 22454, 23086

22458 **(BNL—51862) Leaching Mechanisms Program. Annual report.** Dougherty, D.; Colombo, P.; Doty, R.; Fuhrmann, M. (Brookhaven National Lab., Upton, NY (USA)). Sep 1984. Contract AC02-76CH00016. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009276.

The primary goal of this work is to determine the leaching mechanisms of a variety of matrix materials either in use or being considered for the solidification of low-level radioactive wastes by defense and commercial waste generators. Since this program is new and did not formally begin until May of FY 84, the results reported here are few and preliminary. Efforts were concentrated in the following activities: (1) The literature search for leaching data and proposed leaching models and mechanisms for low-level waste. (2) Data base development for leaching data being compiled from the literature and from the leaching experiments in this program. (3) The selection of solidification agents for the experimental part of the program. (4) Fabrication of leach samples and initiation of leach testing. 28 references, 9 figures, 4 tables.

22459 **(BNL-NUREG—36197) Release of organic reagents from solidified decontamination wastes.** Piciulo, P.L.; Adams, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 6p. (CONF-850314—44). NTIS, PC A02/MF A01. File Number TI85009764.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

In order to provide technical information needed by the US Nuclear Regulatory Commission to evaluate the adequacy of near-surface disposal of decontamination wastes, Brookhaven National Laboratory has measured the release of organic reagents from solidified simulated decontamination wastes. The waste streams consisted of either mixed-bed ion-exchange resins or anion exchange resins equilibrated with EDTA, oxalic acid, citric acid, picolinic acid or simulated LOMI decontamination reagent. These simulated resin wastes were solidified in either cement or vinyl ester-styrene. Samples were tested by a fixed interval leach procedure or according to the standard ANS 16.1 procedure. The leachability indices, which were calculated as prescribed in ANS 16.1, varied with leach period for some of the composites tested. 4 references, 6 figures, 2 tables.

22460 **(NUREG/CR—3709) Methods of minimizing ground-water contamination from in situ leach uranium mining. Final report.** Deutsch, W.J.; Martin, W.J.; Eary, L.E.; Serne, R.J. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 157p. (PNL—5319). NTIS, PC A08/MF A01 - GPO $5.50. File Number TI85010011.

This is the final report of a research project designed to study methods of minimizing ground-water contamination from in situ leach uranium mining. Fieldwork and laboratory experiments were conducted to identify excursion indicators for monitoring purposes during mining, and to evaluate effective aquifer restoration techniques following mining. Many of the solution constituents were found to be too reactive with the aquifer sediments to reliably indicate excursion of leaching solution from the ore zone; however, in many cases, the concentrations of chloride and sulfate and the total dissolved solids level of the solution were found to be good excursion indicators. Aquifer restoration by ground-water sweeping consumed large quantities of ground water and was not effective for the redox-sensitive contaminants often present in the ore zone. Surface treatment methods such as reverse osmosis and electrodialysis were effective in reducing the amount of water used, but also had the potential for creating conditions in the aquifer under which the redox-sensitive contaminants would be mobile. In situ restoration by chemical reduction, in which a reducing agent is added to the solution recirculated through the ore zone during restoration, can restore the ore-zone sediment as well as the ground water. This method could lead to a stable chemical condition in the aquifer similar to conditions before mining. 41 figures.

22461 **(PNL-SA—12569) Field sampling design and method of statistical analysis to define the areal extent of PCB contamination in low-level waste pond sediments.** Prohammer, L.A.; Riley, R.G.; Thomas, J.M. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 13p. (CONF-850314—46). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009433.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

This study demonstrates a cost-effective, site-specific field sampling program and statistical analysis scheme to estimate the areal extent of organic chemical contamination in low-level chemical and radioactive waste pond sediments. This approach was used

to estimate the distribution of polychlorinated biphenyls (PCB's) in a Hanford area low-level waste pond. Using the statistical technique of kriging, a contour map of PCB concentrations in the pond was developed. The kriging analysis produced variance estimates about the contours, allowing evaluation of the estimated PCB concentrations and the ability to optimize placement of further sampling effort. Results of the study indicated that PCB concentrations in the pond sediments were generally less than 100 ppB.

22462 **(RHO-RE-SA—45-P) Trace cobalt sorption on 21 sediment types from the Hanford site, Washington.** Routson, R.C.; Barney, G.S.; Delegard, C.H.; Smith, R.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Feb 1985. Contract AC06-77RL01030. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009693.

Studies were conducted at the Hanford site in Washington State to measure the 200 East and 200 West Separation Areas' sorption properties for trace cobalt (^{60}Co). Twenty-one sediment types were delineated from five wells. Twenty-one empirical distribution coefficient (Kd) equations were developed for trace ^{60}Co sorption of 21 sediment types from the Hanford Site 200 Separation Areas. The coefficients in these equations for ^{60}Co were internally of the same general form. Average coefficient values were computed for ^{60}Co and compared with individual sediment type coefficients. These data are required for the transport modeling of ^{60}Co in varied sodium, calcium, and potassium soil-water systems. A sensitivity analysis of retardation factor values for two selected sediment chemical systems were evaluated to determine if additional 200 Separation Areas' sediment measurements are required. Retardation factors were compared for paired sediment types which occupy similar stratigraphic locations in the sampled wells. 20 references, 7 figures, 11 tables.

22463 **(SAND—83-1276) User's manual for the radionuclide migration code IONMIG.** Russo, A.J. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009990.

The computer code IONMIG, which is used to calculate the far-field transport of decaying radionuclides through a porous medium by diffusion and convection, has been developed in support of the United States Subseabed Disposal Program. Planar or axisymmetric two-dimensional geometries can be treated with either explicit or implicit solvers. A previous document, Prediction of the Migration of Several Radionuclides in Ocean Sediment with the Computer Code IONMIG: A Preliminary Report, SAND79-1666, described the theory and numerical methods used in the explicit solver. This report is a user's guide for the code. 10 references, 14 figures.

22464 **(USGS/WRI—83-4124) Geologic and well-construction data for the H-10 borehole complex near the proposed Waste Isolation Pilot Plant site, southeastern New Mexico.** Wells, J.G.; Drellack, S.L. Jr. (Geological Survey, Albuquerque, NM (USA)). 1983. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009020.

The H-10 borehole complex, a group of three closely spaced boreholes, is located 4 miles southeast of the proposed Waste Isolation Pilot Plant site in west-central Lea County, New Mexico. The holes were drilled during August and October 1979 to obtain geologic and hydrologic data to better define the regional groundwater-flow system. The geologic data presented in this report are part of a site-characterization study for the possible storage of defense-associated radioactive wastes within salt beds of the Salado Formation of Permian age. The geologic data include detailed descriptions of cores, cuttings, and geophysical logs. Each borehole was designed to penetrate a distinct water-bearing zone: H-10a (total depth 1318 feet) was completed just below the Magenta Dolomite Member of the Rustler Formation of Permian age; H-10b (total depth 1398 feet) was completed just below the Culebra Dolomite Member of the Rustler Formation; and H-10c (total depth 1538 feet) was completed below the Rustler Formation-Salado Formation contact. The geologic units penetrated in borehole H-10c are surficial alluvium and eolian sand of Holocene age (0 to 5 feet); the Mescalero caliche (5 to 9 feet) and the Gatuna Formation (9 to 90 feet) of Pleistocene age: formations in the Dockum Group (Chinle Formation, 90 to 482 feet and Santa Rosa Sandstone, 482 to 658 feet) of Late Triassic age; and the Dewey Lake Red Beds (658 to 1204 feet), the Rustler Formation (1204 to 1501 feet), and part of the Salado Formation (1501 to 1538 feet), all of Permian age. The sections of the Rustler and Salado Formations penetrated by borehole H-10c are complete and contain little or no evidence of dissolution of halite and associated rocks, indicating that the eastward-moving dissolution within the Rustler or on top of the Salado, found west of the Waste Isolation Pilot Plant site, has not reached the H-10 site.

0540 Health And Safety

REFER ALSO TO CITATION(S) 05400022424

22465 **(NUREG/CR—3611) Radioactive material (RAM) accident/incident data analysis program.** Emerson, E.L.; McClure, J.D. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 40p. (SAND—82-2156). NTIS, PC A03/MF A01 - GPO. File Number TI85010382.

This report describes the development of the Radioactive Material Transportation Accident/Incident Data Base (RAM-AIDB), which contains information on the occurrences of transportation accidents and incidents, for radioactive materials (RAM) that are involved in the process of transportation, loading and unloading operation, or temporary storage. These transportation operations are in support of the nuclear fuel cycle for electrical energy generation. This study analyzes in some detail basic accident/incident statistical data, RAM packaging accident response data, and the health effects associated with RAM transport accidents/incidents. This report presents a summary of US RAM transport accident/incident experience for the period 1971 through December 1981. In addition, a sample annual summary of accident/incident experience is presented for the calendar year 1981.

22466 **(ORNL/CSD/TM—225) Review of PGDP assessment of criticality safety problems in increasing product assay to 5 wt % ^{235}U.** Petrie, L.M.; Turner, J.C.; Stewart, G.B. (Oak Ridge National Lab., TN (USA)). Feb 1985. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008765.

Paducah Gaseous Diffusion Plant (PGDP) performed an evaluation of the PGDP facilities to determine the feasibility of increasing product assay from 2.0 wt % to 5.0 wt % ^{235}U and to determine the impact of this increase on plant criticality safety; their conclusions are reported in KY-710. This report critiques the methods used and conclusions reached in KY-710. 4 figures, 5 tables.

22467 **(PNL-SA—12441) Review of standards and guidelines pertinent to DOE's remedial action programs.** Soldat, J.K.; Denham, D.H. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 24p. (CONF-841187—29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005289.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

A number of radiological standards, guidelines, and dose criteria have been promulgated that may be relevant to the Department of Energy's (DOE) Remedial Action programs. Some of these will be applied to remedial actions undertaken by DOE to ensure that health and safety aspects will be adequately addressed. Pacific Northwest Laboratory staff are reviewing and evaluating existing and proposed environmental radiological standards and criteria for their applicability. National and international environmental standards and criteria, and studies conducted by other DOE contractors are being evaluated. The aim of the review is to identify gaps in these standards and guidelines and to recommend further development as necessary. This paper provides a summary of the standards and guidelines evaluated for applicability to DOE's Remedial Action programs. 33 references, 5 tables.

22468 **(SAND—84-0548) Radiological protection options for subseabed high-level waste disposal.** Kaplan, M.F.; Klett, R.D.; Koplik, C.M.; Ensminger, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009819.

This report defines the radiological protection criteria options that apply to nuclear waste disposal. The history of radiological protection is examined and existing national and international laws and regulations are reviewed. Problems particular to subseabed disposal are discussed. This review is the first step in developing working standards for Subseabed Disposal Program sensitivity and feasibility studies.

0550 Regulations

22469 **(NUREG—0430-Vol.5-No.1) Licensed fuel facility status report. Inventory difference data, January-June 1984. Volume 5, No. 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Apr 1985. 14p. NTIS, PC A02/MF A01 - GPO. File Number TI85901327.

NRC is committed to the periodic publication of licensed fuel facilities' inventory difference data, following agency review of the information and completion of any related investigations. Information in this report includes inventory difference data for active fuel fabrication facilities possessing more than one effective kilogram of high enriched uranium, low enriched uranium, plutonium, or Uranium-233.

22470 **(NUREG—1130) Environmental assessment for renewal and consolidation of Materials License Nos. SNM-362, SMB-405, 08-00566-05, 08-00566-10, and 08-00566-12 (Docket No. 70-398).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Mar 1985. 44p. NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85901224.

The proposed action for which this Environmental Assessment is prepared is the renewal and consolidation of five nuclear materials licenses for radiological activities at the National Bureau of Standards (NBS) site. These licenses cover most uses of radioactive material at NBS except that controlled by the license for operation of the NBS reactor. The reactor license is not associated with and will not be affected by the currently proposed licensing action.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

22471 **(DOE/NDC—35) Stable isotope research pool inventory.** (Oak Ridge National Lab., TN (USA); USDOE Office of Energy Research, Washington, DC. Chemical Sciences Div.). Feb 1985. Contract AC05-84OR21400. 61p. (INDC(USA)—95; NEANDC(US)—220). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009974.

This report contains a listing of electromagnetically separated stable isotopes which are available at the Oak Ridge National Laboratory for distribution for non-destructive research use on a loan basis. This inventory includes all samples of stable isotopes in the Research Materials Collection and does not designate whether a sample is out on loan or is in reprocessing. For some of the high abundance naturally occurring isotopes, larger amounts can be made available; for example, ^{40}Ca and ^{56}Fe. All request for the loan of samples should be submitted with a summary of the purpose of the loan to: Isotope Distribution Office, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831. Requests from non-DOE contractors and from foreign institutions require DOE approval.

22472 **(MLM—3234) Stable isotope sales: Mound customer and shipment summaries, FY1983.** Gridley, J. (comp.). (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 12 Apr 1985. Contract AC04-76DP00053. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010209.

A listing is given of Mound's sales of stable isotopes of noble gases, deuterium, carbon, oxygen, nitrogen, chlorine, bromine, and sulfur for fiscal year 1983. Purchasers are listed alphabetically and are divided into domestic and foreign groups. A cross-reference index by location is included for domestic customers. Cross-reference listings by isotope purchased are included for all customers.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 07020023017, 23018, 23024

22473 (DOE/ER/10275—1B, pp 31) **Development of 2.0 to 9.0 MeV gamma sources.** Holland, J.P.; Powell, G.T. (Texas A and M Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

22474 **(UCID—20299) RTNS-II operations guidebook.** Heikkinen, D.W. (Lawrence Livermore National Lab., CA (USA)). 1 Apr 1985. Contract W-7405-ENG-48. 74p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010030.

This guidebook is intended to provide training criteria, procedures and guidelines for operation of the RTNS-II neutron sources and ancilliary equipment. Use of this document requires full knowledge of the RTNS-II Facility Safety Procedure (FSP) and any Operational Safety Procedures (OSP) in effect. The RTNS-II FSP defines the hazards which may be encountered at RTNS-II and defines the procedures which must be followed in performing any task including operations. The purpose of this document is to provide a central source of detailed information concerning systems and equipment used in operating the RTNS-II neutron sources on a day-to-day basis. All members of the Operations Group are expected to be familiar with its contents. It is also intended to be used in training new members of the Operations Group.

08 HYDROGEN

0801 Production

22475 **(DOE/BP—236) Feasibility of electrolytic hydrogen production in the Pacific Northwest. Final report.** Pratt, J.; Butcher, W.; Steinmann, L.; Blazek, C.; Daniels, E. (USDOE Bonneville Power Administration, Portland, OR. Office of Engineering and Construction). Sep 1984. 272p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85009856.

This report concludes the first phase of a two-phase project to analyze the feasibility of hydrogen production and to demonstrate the technology. In this first phase, the hydroelectric surplus was analyzed and its characteristics related to the requirements of an electrolysis plant. The state-of-the-art in hydrogen conversion processes (electrolyzers and fuel cells) was reviewed by the Institute of Gas Technology and a technical feasibility analysis was completed which addressed electrolyzers currently available from manufacturers, compressor and storage equipment, transportation technology, and hydrogen compatibility with existing Northwest pipelines and equipment. Using these data, an economic feasibility analysis was undertaken and the production cost of hydrogen was calculated. The relationships between cost of hydrogen and type of electrolyzer, price and availability of power, level of installed capacity, annual utilization factor, and cost of capital were outlined, and the cost-competitiveness of electrolytic hydrogen with other fuels and with steam-reformed hydrogen was assessed. Finally, a preliminary survey of Northwest hydrogen markets and concerns was completed. In follow-on Phase I work, the hydrogen cost cal-

culation model (HYDROGEN.BAS) was rewritten and verified, additional production cost cases were run, and a more in-depth review of Northwest industrial markets and hydrogen venture financing was completed. 72 references, 52 figures, 60 tables.

22476 **(PB—85-149706/XAB) Solar-assisted hydrogen generation by photoelectrocatalysis. Annual report, 1 October 1983-30 September 1984.** Sammells, A.F.; Wessels, B.W.; Raccah, P.M.; Cook, R.L.; Ang, P.G.P. (Eltron Research, Inc., Aurora, IL (USA)). Dec 1984. 144p. NTIS, PC A07/MF A01.

See also PB83-211904. Prepared in cooperation with Northwestern Univ., Evanston, IL and Illinois Univ. at Chicago Circle.

This research effort is directed towards gaining basic insight into those factors which will help to improve the efficiency of hydrogen generation in photoelectrochemical cells. Emphasis of the program is on photoelectrode surface modification as an approach to improve such efficiencies. Both electrooptical and photoelectrochemical techniques are being used to characterize photoelectrode surfaces and includes photocapacitance spectroscopy and automatic scanning ellipsometry techniques. For surface modified p-InP the dependency of exchange current density as measured before and after the inception of hydrogen evolution has been examined as a function of incident light intensity. This was performed using the surface modifications Co/Pt, Ru/Pt, Rh/Pt, Ru, Pt, Rh and Co. Experimental results indicated that a progressively lower applied cathodic bias is required for hydrogen evolution in the order Ru/Pt < Rh/Pt < Co/Pt < Rh < Pt < Co < Ru < unmodified. Photoelectrode kinetics on alpha-Fe2O3 based photoanodes can be enhanced by the incorporation of platinum within the thermally grown oxide. A model is evolving which invokes the role surface states play in this order and in determining the shape of the experimental io vs incident light flux curves. The overall solar efficiency, as power savings for photoelectrochemical cells using a p-InP photocathode surface modified by sequential deposited Co and Pt and a platinum counter electrode, have been increased to 16% in alkaline electrolytes by depolarization of the counter electrode with monosaccharides.

0802 Storage

REFER ALSO TO CITATION(S) 08020022475

0804 Marketing And Economics

REFER ALSO TO CITATION(S) 08040022498

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 08060022475

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 09012022295, 22492, 22819, 22939

22477 **(DOE/PC/30021—T17) Catalyst and reactor development for a liquid phase Fischer-Tropsch process. Quarterly technical progress report, 1 January-31 March 1984.** Carroll, W.E.; Cilen, N.; Motika, S.A. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Mar 1985. Contract AC22-80PC30021. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008457.

In the fourteenth quarter work continued for two major tasks: (1) Slurry Catalyst Development, and (2) Proprietary Catalyst A Development. The proprietary catalyst A work is part of a contract modification, begun last quarter, to improve the activity and center the selectivity for diesel fuel products of this catalyst. The basis of this work stems from promising results during extended testing of this catalyst. Variation of catalyst pretreatment methods and promoter levels are intended. Slurry catalyst development - Parametric gas phase screening tests were concluded on a modified conventional catalyst and an optimum preparation and activation procedure chosen for diesel fuel selectivity. A short term (≃ 21 day) slurry test of this catalyst exhibited appreciable activity, but poor selectivity for diesel fuel products. The selectivity varied strongly with CO/H_2 ratio, but even at $CO/H_2 = 2.0$, products were predominantly below C_{16}. Catalyst A development - Three tests were conducted this quarter to determine the effects of varying the promoter levels of catalyst A. In summary, the basecase catalyst composition of this catalyst remained to be the most selective for diesel fuel. In activity level, a catalyst A' out-performed the activity of all catalysts tested to date. Surface analysis studies are underway to aid in understanding these effects and in so doing, optimizing the promoter levels for maximum activity and diesel fuel selectivity. Gas phase screening tests were conducted on catalyst A to determine the effects of activation and pretreatment procedures on activity and product selectivity. In general, no appreciable differences in bulk activity and only slight differences in hydrocarbon distribution were observed in the three tests conducted.

22478 **(DOE/PC/50816—9) Metal boride catalysts for indirect liquefaction. Quarterly technical progress report, September 1-November 31, 1984.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 20 Feb 1985. Contract FG22-82PC50816. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85006666.

During the ninth quarter a sodium-free iron boride catalyst was prepared by boronation with B_2H_6/H_2. Its unusually large hydrogen uptake upon cooling in hydrogen suggests the formation of an iron boron hydride. Our reactor system was completely reconstructed to enable activity tests of catalysts at pressures up to 400 psig (27 atm). Two unsupported cobalt boride catalysts, one prepared in aqueous solution and the other in ethanolic solution, were tested for CO hydrogenation activity and selectivity at 6 atm. Product distributions were obtained after 15 to 30 hours of reaction. The results indicate that unsupported sodium-prompted cobalt boride, prepared in ethanolic solution, has a high selectivity for C_8-C_{12} hydrocarbons and C_3-C_8 olefins. The CO_2 yield is lower at 6 atm compared to that at 1 atm. The principal investigator attended 4 meetings, visited one University, presented 5 talks, and hosted 2 visitors. 23 references, 6 figures, 4 tables.

22479 **(DOE/R3/06268—T1) [Methane digester]. Final report.** Waybright, R.C. (Mason Dixon Farms, Inc., Gettysburg, PA (USA)). 1981. Contract FG43-80R306268. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009328.

The purpose of the grant was to construct and operate a methane digester for dairy manure involving the latest state-of-the-art technics. The first step taken was to empty out the existing digester to evaluate its performance and to gain ideas of how to build the next digester so it would operate more efficiently. Next, the design criteria was set up in order to eliminate some problems involved with the first digester and also new ideas as to how to build the next one without a protective building and testing simplified construction technics. After this the digester construction was started with the completion date in late January. The digester was then filled and operated at different temperatures attempting to achieve the optimum operating range.

22480 **(EPRI-AP—3865) Biomass gasification for electric utility diesel generating units. Final report.** Schroeder, R.J.; Ege, H.D.; Hunt, F.E. (Burns and McDonnell Engineering Co., Kansas City, MO (USA)). Feb 1985. 106p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00. File Number TI85920506.

The gasification of biomass to produce a low-Btu gas has experienced renewed interest in the wake of worldwide fuel cost and availability concerns. A potential use of low-Btu gas is for electric generation, but the application of this gas to generate electricity has generally been limited to experimental or small commercial operations. This report assesses the technical feasibility of using biomass-derived low-Btu gas as a fuel source for existing electric utility diesel generating units. The assessment is based on three activi-

ties: a literature review, a survey of commercial suppliers, and site visits to operating gasifier/engine facilities. Extensive research and experimentation has been directed to gasifier/engines for electric generation. However, at present, no operating systems appear to meet electric utility power plant reliability standards. To establish the technical feasibility of this concept, a demonstration effort is suggested. 79 references, 26 figures, 14 tables.

22481 **(PB—85-136745/XAB) Assessment of large-scale biomass gasification systems for less-developed countries.** Baker, E.G.; Mitchell, D.H.; Williford, J.F. (Battelle-Northwest, Richland, WA (USA). Pacific Northwest Lab.). Sep 1980. 126p. NTIS, PC A07/MF A01.

This state-of-the-art report evaluates large-scale biomass gasification systems both economically and technically and analyses their potential applications in developing countries. After a discussion of biomass feedstock types, handling, and preparation, the authors describe various types of gasifiers available (fixed-bed updraft and downdraft, fluid-bed, and entrained-bed) and their current applications. Gasification chemistry, advanced gasification systems, and gas cleaning are also considered. Next, the use of fuel gas from biomass for steam power production, other fired equipment, internal combustion engines for power production, gas turbine cycles, synthesis of methanol and other liquid fuels, and synthesis of ammonia and other chemicals, is discussed. The environmental impacts of biomass gasification are reviewed. The authors conclude that availability of sufficient feed materials is essential for large-scale biomass gasification in developing countries. The most promising applications are: (1) rural electrification using air-blown biomass gasifiers and diesel generators; (2) retrofitting existing oil and gas fired equipment in various industries, particularly in agricultural processing plants; and (3) producing ammonia-based fertilizers from biomass-derived synthesis gas.

22482 **(PB—85-140184/XAB) State-of-the-art report on pyrolysis of wood and agricultural biomass.** Chatterjee, A.K. (Chatterjee (Anil K.), Newark, CA (USA)). Mar 1981. 249p. NTIS, PC A11/MF A01.

Pyrolysis of agricultural and forestry biomass, which yields clean-burning, high-energy fuels such as charcoal, pyrolytic oil, and fuel gas, provides energy-poor developing countries the most appropriate technology for using alternative energy resources. So concludes this state-of-the-art review, based on a literature search, of biomass pyrolysis. The author defines the thermochemical conversion theory and basic pyrolysis processes and provides descriptions of typical and specific processes; lists potential and available biomass resources, along with the biomass properties relevant to pyrolytic conversion; and discusses the collection, storage, and preprocessing of biomass feedstock, as well as the recovery of the converted products. Case studies of pyrolysis activities in developing and developed countries are presented, along with an economic analysis of a biomass pyrolysis conversion facility and a brief discussion of the environmental effects of the conversion process. Recommendations for countries seeking to employ biomass pyrolysis conclude the study. Appended are a list of resource persons and institutions and a 53-item bibliography (1961-81).

22483 **(PB—85-156958/XAB) Biogasification of Walt Disney World biomass waste blend. Annual report, January-December 1983.** Biljetina, R.; Chynoweth, D.P.; Janulis, J.; Srivastava, V.J. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1984. 181p. NTIS, PC A09/MF A01.

See also PB83-242636.

The objective of this research is to develop efficient processes for conversion of biomass-waste blends to methane and other resources. To evaluate the technical and economic feasibility, an experimental test unit (ETU) was designed and installed at the Reedy Creek Wastewater Treatment Plant at Walt Disney World in Lake Buena Vista, Florida. The facility integrates a biomethanogenic conversion process with a wastewater treatment process employing water hyacinth ponds for secondary and tertiary treatment of sewage. Harvested water hyacinth is subsequently combined with sludge from the primary wastewater clarifier and fed at 1-wet-ton per day to the ETU digester. This results in the production of methane and other useful byproducts. Design, procurement of equipment, and installation has been completed. Start-up of the ETU is in progress.

22484 **(PB—85-156966/XAB) Biological gasification of renewable resources. Annual report, January 1983-February 1984.** Chynoweth, D.P.; Fannin, K.F.; Jerger, D.E.; Srivastava, V.J.; Conrad, J.R. (Institute of Gas Technology, Chicago, IL (USA)). Nov 1984. 174p. NTIS, PC A08/MF A01.

The objective of this project was to determine the best reactor configuration and optimum operating conditions for anaerobic digestion of each of four prototype feeds--water hyacinth/sludge, kelp, sorghum, and poplar--representing feedstocks of varying particulate and lignin content. A kinetic analysis of two different reactor types recovering a blend of water hyacinth and sludge indicated better performance of a non-mixed upflow solids reactor (USR) to that of a continuously stirred tank reactor (CSTR). The results of preliminary lab analyses and systems calculations suggest that substantial improvement in performance is possible by digestion of low-solids juice in an ambient temperature reactor and hyacinth solids in a different reactor. A kinetic analysis of kelp digestion also indicated superior performance of the USR over the CSTR digester. Conversion yields and rates and process stability were shown to be greater in a kelp lot with higher mannitol content. The biodegradability of sorghum was as high as 87% theoretical. The USR exhibited superior performance to that of the CSTR on this feedstock. Particle size reduction did not effect rates on yields in the range of 0.06 to 0.3 inches. Ensiling resulted in rapid production of fermentation products, including carbon dioxide, hydrogen, and volatile acids. High conversion and associated methane yields was observed during digestion of diluted poplar. Both methane yield as production rates were adversely affected at increasing solids concentrations. Preliminary results suggest that a two-phase leachate bed recycle system may be most effective for biogasification of wood.

22485 **(PB—85-159457/XAB) Anaerobic digestion of biomass: status summary and research and development needs, 1983 (condensed version). Topical report for January-October 1983.** Chynoweth, D.P.; Fannin, K.F.; Jerger, D.E.; Srivastava, V.J.; Biljetina, R. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1984. 30p. NTIS, PC A03/MF A01.

See also PB85-161925.

This condensed report reviews the status of anaerobic digestion from the perspective of producing methane from biomass. Research needs are discussed and listed with prioritization. The report is divided into three sections. The first section, Microbial Ecology, reviews hydrolytic, intermediate, and methanogenic bacteria. The second section, Feed Characteristics, reviews feed composition, pre-/posttreatment, nutrient requirements, and toxicity. The third section, Process Design, Operation, Evaluation, and Control, reviews reactor designs, process start-up, operation, stability and control, kinetics and modeling, net energy, and process scale-up and commercialization.

22486 **(PB—85-161925/XAB) Anaerobic digestion of biomass: status summary and research and development needs, 1983. Topical report, January-October 1983.** Chynoweth, D.P.; Fannin, K.F.; Jerger, D.E.; Srivastava, V.J.; Biljetina, R. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1984. 315p. NTIS, PC A14/MF A01.

See also PB85-159457.

This report reviews the status of anaerobic digestion from the perspective of producing methane from biomass. Research needs are discussed and listed with prioritization. The report is divided into three sections. The first section, Microbial Ecology, reviews hydrolytic, intermediate, and methanogenic bacteria. The second section, Feed Characteristics, reviews feed composition, pre-/posttreatment, nutrient requirements, and toxicity. The third section, Process Design, Operation, Evaluation, and Control, reviews reactor designs, process start-up, operation, stability and control, kinetics and modeling, net energy, and process scale-up and commercialization.

22487 **(PB—85-161933/XAB) Sorghums for methane production. Annual report, April 1983-March 1984.** Hiler, E.A.; Miller, F.R.; Monk, R.L.; McBee, G.G.; Creelman, R.A. (Texas Agricultural Experiment Station, College Station (USA)). Jun 1984. 170p. NTIS, PC A08/MF A01.

The objective of this research is to develop an integrated system for methane production utilizing high-energy sorghum as the feedstock. Because of its wide geographic adaptability, its high gas-production potential, and the fact that it is already cultivated on over 15 million acres annually in the U.S., sorghum represents a significant potential energy resource that can be converted to methane by anaerobic digestion. This report provides specifics of research activities in the sorghums-for-methane program sponsored by Gas Research Institute and cofunded by Texas Agricultural Experiment Station. Researchers in the program include plant breeders, sorghum physiologists, agronomists, agricultural and systems engineers, and agricultural economists. Major research emphases are genetic manipulation, physiology and production systems, harvesting, storage, processing, and conversion systems; and economic and systems analyses. First-year results indicate that: (1) the proposed sorghum-methane system is in the realm of economic feasibility, and (2) research emphases in storage and high-efficiency conversion are critical to the economic implementation of the system. An innovative approach to combine the storage and conversion processes in a two-stage system is being investigated. Increased research emphasis is being placed on storage and conversion aspects of the system.

22488 **(PB—85-161941/XAB) Investigation and optimization of fuel production using dye-based transition metal complexes as charge-transfer intermediates. Annual report, August 1983-August 1984.** Shelnutt, J.A.; Ginley, D.S. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. 244p. NTIS, PC A11/MF A01.

Metalloporphyrins offer promising properties for photosensitizing and catalyzing reactions of interest. Because of the detailed understanding of these molecules at a fundamental level, they provide a unique chemical system for investigations of the basic photophysical processes controlling desired chemistries. Therefore, spectroscopic studies of metalloporphyrins in fuel-producing environments were initiated with the goal of determining the factors controlling their photochemical reactivity. Metalloporphyrins perturbed systematically either by structural modifications or by incorporation into various environments were examined by resonance Raman difference spectroscopy, ultraviolet/visible absorption spectroscopy, and other spectroscopic and electrochemical probes. Perturbations on the photosensitizing chromophore resulted in systematic changes in its spectra and its chemical properties. A new theoretical procedure that uses a model of metalloporphyrin electronic states has been applied to quantitatively evaluate systematic differences in the spectra. Efforts to relate metalloporphyrin structure to photochemical activity in an artificial photosynthesis system have begun. For example, the unusually high activity of an anionic tin porphyrin was traced to prevention of formation of inactive complexes by blocking groups attached to the metal. Subsequent studies have shown that blocking groups also prevent aggregation--another inactivating process. Besides this solution system, a number of metalloporphyrin-polymer based systems are being investigated.

22489 **(PNL-SA—12938) Thermochemical gasification of high-moisture biomass feedstocks.** Butner, R.S.; Sealock, L.J. Jr.; Elliott, D.C. (Pacific Northwest Labs., Richland, WA (USA)). 14 Feb 1985. Contract AC06-76RL01830. 9p. (CONF-850240—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008517.

From Alternative energy in the Midwest: research and applications; Schaumburg, IL, USA (21 Feb 1985).

A significant energy resource base exists in the Midwest in the form of crop residues and wastes. Estimates have been made that this resource is on the magnitude of 1.5 Quads (1 Quad = 10^{15} Btu's). One obstacle to the full utilization of this resource is the high moisture content of many crop residues. A DOE-funded research program being conducted by Pacific Northwest Laboratory is investigating a low-temperature, mixed catalyst thermochemical system which efficiently converts high-moisture biomass to a medium Btu gas consisting of methane and hydrogen. Experimental data indicates that carbon conversions in excess of 90% may be obtained. Feedstock slurries containing up to 95% moisture have been used successfully in the batch reactor. Feedstocks used in the system include sorghum, sunflowers, napier grass, aquatic plants and food processing wastes. The ability to convert high-moisture biomass to fuels via this thermochemical process may allow greater utilization of the significant biomass resource base which exists in the Mdwest. 6 references, 6 figures, 2 tables.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 09022022531, 22819

22490 **(DOE/CE/50036—1) Impact of alcohol fuels on urban air pollution: methanol photochemistry study. Final report.** Pefley, R.K.; Pullman, B.; Whitten, G. (Santa Clara Univ., CA (USA). Dept. of Mechanical Engineering). Nov 1984. Contract FG03-84CE50036. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009539.

Experimental evidence has been obtained to support methanol's low photochemical reactivity when substituted for typical urban hydrocarbons. This evidence supports a previous urban modeling study in which significant ozone reductions were predicted with large scale methanol substitution for gasoline. An improved (urban hydrocarbon) chemical kinetic mechanism has also been partially validated along with methanol's photochemistry. 15 references, 28 figures, 7 tables.

22491 **(DOE/ER/10096—T17) Ethanol production by bacterial fermentation.** King, F.G. (Howard Univ., Washington, DC (USA). Dept. of Chemical Engineering). [1985]. Contract FG05-78ER10096. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011086.

The goal of this study is to develop and optimize the process technology for the production of ethanol using the bacteria Zymomonas mobilis. Specifically, the process and operating conditions will be studied to maximize the yield of ethanol. The experimental design is described using both batch and continuous cultures with glucose as the substrate. Separation methods, therefore, will be developed to remove the alcohol from the fermentation media to prevent the inhibitory effects of ethanol on Z. mobilis. Vacuum fermentation and solvent extraction can be used to separate the alcohol from the media. Kinetic data will be obtained from both the batch and continuous fermentors. The kinetic data can be correlated using mathematical models. Mathematical models for Z. mobilis will be developed for the effect of pH, temperature and nutrient composition on the specific growth rate. A model will also be developed to account for the possible product inhibition by ethanol. Dynamic tests will also be conducted on the continuous system to determine how fast the fermentation will respond to environmental changes. The simultaneous hydrolysis of cellulose to glucose and fermentation of glucose to ethanol is one of the most exciting possibilities. A literature survey will be made to determine the compatibility of conducting the hydrolysis reaction along with the bacterial fermentation. The final objective will be to make an economic assessment of the process of producing ethanol using Z. mobilis.

22492 **(DOE/ER/10720—16) Study of synthesis gas conversion over metal oxides. Progress report, August 1, 1984-July 31, 1985.** Ekerdt, J.G. (Texas Univ., Austin (USA)). 1985. Contract AS05-80ER10720. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010136.

The objectives of the research are identification of the reaction intermediates present during CO hydrogenation over metal oxides, determination of the reaction mechanisms, and a description of the active site and how the metal cations and lattice oxygens participate in the CO hydrogenation reactions. Zirconium dioxide was selected for study because it catalyzes the formation of aromatics and highly branched alkanes in a process referred to as isosynthesis. The research has continued at atmospheric and at high pressures during the past year. The atmospheric work concentrated on methanol synthesis mechanisms and surface reactions. The high pressure work has been directed toward an identification of the carbon-carbon chain growth step during isosynthesis. Previous studies at one atmosphere have revealed that CO and H_2 interact with ZrO_2 to form the formate, oxymethylene, and methoxide structures. Methoxide reacted to methane in the presence of gas phase H_2 and to methanol in the presence of gas phase H_2O. We continued to investigate the process whereby methanol was formed. The role of water in methanol formation was addressed using oxygen-18 labeled H_2O and CO. These labeling studies have also

provided insight into the manner by which formate is formed at a ZrO_2 surface. The high pressure studies have not been as conclusive as the atmospheric studies but are beginning to show promise. Earlier work had revealed that C_4 products were formed in a stepwise fashion between a C_1 and a C_3 species. The earlier work had also revealed that isobutene and 1-butene were the primary products at low conversion (<5%) and a pressure of 35 atm and that these primary products were most likely formed from a common intermediate. 6 references, 6 figures, 2 tables.

22493 (DOE/R3/02392—T1) Establishing capitalization and marketing for 190 proof alcohol plants. Final report. Bardaglio, D.; Holway, J. (Institute for Local Self Reliance, Washington, DC (USA)). 30 Sep 1983. Contract FG43-80R302392. 54p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009253.

This paper evaluates existing information on community-scale alcohol plants and examines the prospects of using new tax incentives to maximize the direct and indirect economic benefits from the plants for the community. Markets for ethanol and by-products of ethanol production are examined. It appears that municipal solid waste streams offer very attractive possibilities as feedstocks. The municipalities also could be the prime user of the alcohol produced. The tax benefits associated with ethanol production and use offer the key to economic attractiveness to potential investors. Several case studies are included. (DMC)

22494 (DOE/R3/06084—T1) Solar produced alcohol for the small farm. Final technical report. Kriley, D.B. (Kriley Solar Distributors, Harrisville, PA (USA)). [1985]. Contract FG43-79R306084. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009400.

Results obtained during the operation of a small-scale ethanol plant on a farm are reported. It is shown that: (1) ethanol can be produced from corn without the use of expensive commercial enzymes and expensive heating systems; (2) ethanol can be produced the small farm with temperatures under 130°F through the entire process. (Solar energy is definitely usable in these temperature ranges); (3) locally obtained equipment can be used to build a low temperature distillation system (for example, stainless bulk milk tanks, surplus glass, aluminum roofing, etc.); (4) cost per gallon of ethanol is greatly reduced by producing ethanol on farm; and (5) energy consumed to produced ethanol is reduced by as much 30,000 Btu's in the distillation process. The best commercial fossil fuel systems use at least 20,000 Btu in distillation. This alone represents about half of the Btu's normally used in alcohol production. The author recommends that the model farm ethanol plant should use the following equipment: (1) solar heat (ethanol fired backup); (2) continuous fermenter (use less fermentation tanks); and (3) vacuum still (uses low temperature; can utilize stored solar heat more effectively).

22495 (DOE/R3/06091—T1) Ethanol as a fuel: design and construction of an ethanol production facility for a farm. Pelger, E.C. III. (Princeton Univ., NJ (USA)). 1981. Contract FG43-79R306091. 133p. NTIS, PC A07. File Number DE85009420.

This dissertation describes the production of ethanol from biomass. It includes descriptions of photosynthesis, feedstock preparation, fermentation, distillation and end use. Technical problems and limitations as well as social, political, and economic aspects of producing ethanol are addressed. The potential of small-scale ethanol production and specific case studies are reviewed. A low-cost efficient design for a single farm ethanol facility is included. (DMC)

22496 (DOE/R3/06263—T1) Solar energy assisted alcohol fuel system for farm. Eyrich, F.H. (Eyrich (Frederick H.), Oley, PA (USA)). 1 Feb 1984. Contract FG43-80R306263. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010171.

A project is briefly described which would produce ethanol on a farm using LP gas as a heat source and heat recovered from the fermenter to preheat water. (DMC)

22497 (DOE/R3/88089—T1) Ethanol distillation from waste potato starch. Final report, October 1, 1982-September 30, 1983. Shull, H.E. (Pennsylvania State Univ., University Park (USA)). 17 Oct 1983. Contract FG43-81R388089. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009391.

The objective of the project was to investigate the economic feasibility of converting potato waste to fuel alcohol. The source of potato starch was Troyer Farms Potato Chips. Experimental work was carried out at both the laboratory scale and the larger pilot scale batch operation at a decommissioned waste water treatment building on campus. The laboratory scale work was considerably more extensive than originally planned, resulting in a much improved scientific work. The pilot scale facility has been completed and operated successfully. In contrast, the analysis of the economic feasibility of commercial production has not yet been completed. The project was brought to a close with the successful demonstration of the fermentation and distillation using the large scale facilities described previously. Two batches of mash were cooked using the procedures established in support of the laboratory scale work. One of the batches was fermented using the optimum values of the seven controlled factors as predicted by the laboratory scale application of the Box-Wilson design. The other batch was fermented under conditions derived out of Mr. Rouse's interpretation of his long sequence of laboratory results. He was gratified to find that his commitment to the Box-Wilson experiments was justified. The productivity of the Box-Wilson design was greater. The difference between the performance of the two fermentors (one stirred, one not) has not been established yet. Both batches were then distilled together, demonstrating the satisfactory performance of the column still. 4 references.

0903 Inorganic Hydrogen Compound Fuels

22498 (IEA/ICEAS/E—7) Economics of producing ammonia and hydrogen. Stratton, A.; Teper, M. (International Energy Agency Coal Research, London (UK)). Dec 1984. 92p. NTIS (US Sales Only), PC A05/MF A01. File Number TI85901290.

The objective of this report is to identify the circumstances under which coal becomes economically attractive as a feedstock for producing ammonia and hydrogen. In making our analysis, we have considered four feedstocks: natural gas, naphtha, fuel oil and coal. We have included in our comparison the electrolysis of water and the electrochemical gasification of coal. Taking our central capital cost estimates for the Texaco gasifier, cheap-coal at $0.8 to $1.3/GJ in Australia, Canada and USA becomes competitive with fuel oil and naphtha at their current prices of $4.0 to $4.5/GJ, and $6.5/GJ, respectively. Natural gas prices would have to rise to around $7/GJ before cheap coal becomes competitive. In general, electrolysis of water is not competitive with Texaco gasification unless an excess of, for example, hydroelectricity is available over normal market requirements. We conclude that, even at currently depressed oil prices, coal is close to becoming the preferred feedstock for ammonia and hydrogen when natural gas is not available below heating oil substitution cost. This, however, assumes that the capital operating costs and availability of a full-scale, high-temperature, high-pressure gasifier are as indicated in this report. For this to be the case, further development of processes such as Texaco is still required. In turn, this depends on the continuing availability of suitable demonstration facilities. 74 references, 16 figures, 15 tables.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 09040022530, 22791, 22959

22499 (AD-A—148884/0/XAB) Reliability, availability, and maintainability of the Heat Recovery Incinerator at Naval Air Station, Jacksonville. Final report, June 1982-May 1983. Zimmerle, J. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Oct 1984. 78p. (NCEL-TN—1709). NTIS, PC A05/MF A01.

The performance of the Heat Recovery Incinerator (HRI) at Naval Air Station (NAS) Jacksonville, Fla., was studied from June

1982 to May 1983. The study included RAM (reliability, availability, maintainability) analysis of hardware components and five functional missions: (1) processing and incinerating waste and producing steam; (2) processing and incinerating waste; (3) incinerating waste; (4) incinerating waste and producing steam; and (5) combusting fuel oil and producing steam. Eight operational variables were monitored that included: waste generation rate, processing rate, incineration rate, ash production, landfill reduction, energy parameters, processing time, and incineration time. The HRI performed only two of its five missions (2 and 3) during the test period because no steam was produced. Principal problems were failures of the hydraulic system, boiler water levels controls, and storage system. Dust contamination and waste jams necessitated a number of maintenance actions. The HRI was excessively labor intensive which caused the NAS Jacksonville Command to shut down the HRI following the study. The types of design, operation, and maintenance problems that occurred at the facility are discussed, and recommendations are made to correct these problems in future designs.

22500 **(DOE/ET/11286—29) Analysis of drying wood waste fuels with boiler exhaust gases: simulation, performance, and economics.** Kirk, R.W.; Wilson, J.B. (Oregon State Univ., Corvallis (USA)). Sep 1984. Contract AT06-76ET11286. 300p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85006952.

This study evaluates the feasibility of retrofitting a rotary dryer to a hog fuel boiler, using the boiler exhaust gases as the drying medium. Two simulation models were developed. Each model accurately predicts system performance given site-specific parameters such as boiler steam demand, fue moisture content, boiler exhaust temperature and combustion excess air. Three rotary dryers/hog fuel boilers currently in operation in the forest products industry were analyzed. The data obtained were used to validate te accuracy of the simulation models and to establish the performance of boiler/dryer systems under field conditions. The boiler exhaust temperatures observed ranged from 340 to 500°F and indicated that significant drying could be realized at moderate stack temperatures, as substantitated by experimental moisture content data. The simulation models were used to evaluate a general boiler/dryer system's sensitivity to variation in operating conditions. The sensitivity analyses indicated that under moderate conditions (400°F boiler exhaust, etc.) the installation of a rotary dryer results in a 15% increase in boiler efficiency and a 13% decrease in fuel consumption. Both the field data and sensitivity analyses indicated that a greater increase in boiler efficiency could be realized at higher stack temperatures, approximately a 30% increase in boiler efficiency for a stack temperature of 600°F. The cash flow basis payback periods based on hog fuel savings due to dryer installation ranged from 2.7 years for a used dryer to 3.9 years for a new dryer. The payback periods for equivalent BTU savings of gas and oil ranged from 1.2 to 2.0 for gas and from 1.3 to 2.1 years for oil. This study concludes that retrofitting a rotary dryer to an existing hog fuel boiler is an economically feasible option to the forest products industry. 31 references, 24 figures, 18 tables.

22501 **(DOE/R3/02421—T1) Nearly free and sustained fuel for a rural home owner's wood burner. Final report.** Pigott, M.T. (Pigott (Miles Thomas), State College, PA (USA)). 30 Sep 1982. Contract FG43-80R302421. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008991.

To plant one's own firewood on a continuing cyclic basis, I make the following recommendations: (1) First decide whether there is more land, less time or more time, less land. For more land, less time, choose a less crowded spacing. (2) Prepare the land by clearing, soil testing, fertilizing, and mulching with 4 mil 10' x 25' sheets of black plastic. Anchor the plastic by burying the edges with a 20% duty cycle. Mulching will make it unnecessary to mow weeds. (3) Hand dig the holes for the trees, cutting through the prelaid plastic. (4) Spray trees against gypsy moths and Japanese Beetles. The effects of crowding are summarized as follows: there is a 5% gain in growth rate but an 8% loss in ratio of diameter to height. The product of the two yields a 3% loss for each of the crowded trees relative to the selected uncrowded trees. This slight loss per tree, however, is over-shadowed by the gain of 25/9 (278%) afforded by the use of less space. Insofar as extrapolating is permissable, crowding yields a 275% increase in wood/acre. The costs are disappointingly high. Unless the resident has some capital equipment already, he would certainly be tempted to buy his firewood by the cord from some supplier. However, the philosophy underlying the principal motive for such a project is that sources now available will be exhausted if many more residents install wood burning stoves. Growing your own firewood than insures a source.

22502 **(DOE/R3/06070—T1) [Maryland] wood heating project. Final report.** (Maryland Dept. of Natural Resources, Annapolis (USA). Forest and Park Services). 1981. Contract FG43-79R306070. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009424.

The following recommendations and suggestions may be made to the homeowner and small business that might use supplemental wood heat up to 150,000 Btu requirement: (1) The cost of firewood must be kept as low as possible. If costs presently are much over $90/cord there must be very efficient use of the equipment. An owner may be willing to write off the cost of his own labor, but that can rather quickly turn sour if they are not used to heavy work and have the proper equipment to work with. (2) Care must be taken in selecting manufacturer and dealer so that parts and warranty repair are available in the future. We have run into this problem and an owner must beware. (3) A wood or wood/coal furnace is a much better investment than a large wood stove. Costs are less and heat distribution is superior. (4) A small moderately priced stove is better for heating a small area. (5) Wood units must burn hot for satisfactory combustion and heat production. (6) Burning a wood unit in moderate weather creates more problems than it solves. (7) Follow the instructions in the provided manual to the letter. (8) Study wood heat principals before investing in equipment. (9) Insulated chimneys are superior to all others from a practical standpoint. (10) Satisfaction comes only with adequate research and planning all aspects of wood burning. If all personnel involved are not dedicated to its use, results will be less than desirable.

22503 **(DOE/R3/06111—T1) Home fuel from renewable industrial wastes. Fourth quarter and final report.** Hoddinott, R.L. (Resource Recovery, Inc., Midlothian, VA (USA)). 22 Sep 1980. Contract FG43-79R306111. 132p. NTIS, PC A07. File Number DE85008992.

Our objectives were to analyze and understand the sources of selected burnable industrial wastes available in the United States; to find the equipment that would densify the waste into pellets; to package a test quantity; and market test the product for use in home fuel fireplaces and woodburning stoves. An industry survey was completed which indicated that adequate volumes of waste are available to support a nationally distributed retail fuel product. We can project that a minimum of 26 plants capable of producing 10,000 tons of new fuel per year each, would equate to the replacement of 35,000 barrels of OPEC oil annually. The equipment necessary for the processing, densification, and packaging is commercially available. Packaging art and designs were created, and product packaging systems were evaluated. Waste wax paper was purchased, the test product produced, and the packages filled in quantities necessary for the market test. A series of physical testing programs for the evaluation of product safety were carried out that determined the product's effectiveness and safety for retail sales and consumer usage. The market test was conducted during the months of February and March, 1980. Results indicated positive buyer response; good retail and consumer acceptance. Other studies were carried out, including off-season industrial potentials for the fuel product, and a thorough business analysis of the economic viability of the concept.

22504 **(DOE/R3/08054—T1) Alternative fuels for woodburning stoves.** Baroff, J.; Fink, R. (Baroff (James), Edgewater, MD (USA); Fink (Robert), Herndon, VA (USA)). 30 Sep 1982. Contract FG43-81R308054. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009511.

The main conclusion to be drawn from this brief survey of alternative fuels for woodburning stoves is that many potential fuels do exist; however, their use is not widespread. There is a tremen-

dous potential source of fuel which is essentially untapped. The heat content of these fuels is comparable to that of wood and could therefore replace wood if availability and economics are favorable. More work is required to expand on the large body of available data. True comparisons of fuels can only be made by means of in-depth economic feasibility studies which are organized regionally. For example, corn cobs may provide a reasonable fuel in the Mid-west where transportation costs are minimal, but to transport corn cobs to New England would add a sizeable transportation cost in the overall energy cost.

22505 **(DOE/R3/08056—T1) Development of a low-cost booster system for water and space heating. Final technical report.** Green, R. (Action Radiator Repair Service, Inc., Washington, DC (USA)). Oct 1982. Contract FG43-81R308056. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009516.

This report describes a portable booster heater for small shops. The walls are mainly of concrete (although other materials were also tried); the fire box contains a grate and 3/4 inch diameter copper coils through which water is circulated to provide hot water and space heat - considerable heat is also radiated from the walls of the unit. The fuels intended to be used are waste biomass, and other waste materials, such as paper. The unit could be produced cheaply, but there was some worry about building code regulations. The prototype unit performed better than expected in providing temporarily needed heat and reducing the costs of trash removal. (LTN)

22506 **(PB—85-137800/XAB) Direct-combustion systems to produce power from biomass from wood, forest and agricultural crop residue.** Pingrey, D.W.; Waggoner, N.E. (Nor'West-Pacific Corp., Bellevue, WA (USA)). May 1981. 294p. NTIS, PC A13/MF A01.

As an aid to energy planners in the developing world, this report provides a comprehensive state-of-the-art summary of direct-combustion systems for utilizing biomass residues. Off-the-shelf conventional direct combustion systems are identified, their applications are discussed, and constraints to their use in developing countries are evaluated. Attention is given both to the systems economic viability and their potential environmental impacts. Principles of biomass combustion are explained, and tables of biomass fuel analyses and sample combustion calculations are given. Handling and processing of biomass materials, including drying to aid combustion, are discussed. The advantages and disadvantages of biomass-fueled electric power plants are analyzed as are the costs associated with a typical 16-megawatt electric biomass-fueled plant producing 50% cogenerated steam. The appendix lists names and addresses of vendors of combustion systems and equipment needed to handle biomass materials. A 10-page bibliography is included.

0905 Liquid Waste Fuels

22507 **(DOE/R3/08064—T1) Grease/fat waste utilized as a fuel. Final report.** Davis, J.A. (Davis (J.A.), Quantico, MD (USA)). 30 Sep 1982. Contract FG43-81R308064. 49p. NTIS MF A01; 2; GPO Dep. File Number DE85009397.

Chicken processing plants produce wastewater loaded with grease-oil-fat matter. Depending upon plant size, location, and pre-treatment requirements some processing plants discharge untreated wastewater directly into publicly owned treatment works (POTW) while other plants pretreat, removing up to 98% of the grease-oil-fat (GOF) matter, prior to discharging the resulting effluent. The purpose of this study is to evaluate the energy potential of the GOF waste, analyze systems to separate the GOF waste from the process wastewater, select possible incineration systems which may utilize the GOF waste as fuel and recover the heat for plant use. The objective of this project is to theoretically determine if the GOF material, presently disposed of as waste, can be utilized as furnace fuel in a manner which is cost effective. Commercially available equipment in the areas of wastewater pretreatment, incineration, and heat recovery are analyzed for effective utilization. Results indicate that chicken processing plant GOF waste can be effectively utilized as fuel rather than disposed as waste which has compounded problems at landfills, treatment plants, oxidation pools, and receiving waters. 2 figures, 11 tables.

13 HYDRO ENERGY

1302 Site Geology And Meteorology

22508 **(PB—85-146157/XAB) Hydrologic estimation for sizing of small hydropower generation facilities. Final report.** Kurika, M.; Burges, S.J.; Lettenmaier, D.P. (Washington Univ., Seattle (USA). Dept. of Civil Engineering). Aug 1984. 89p. NTIS, PC A05/MF A01.

Small hydropower design decisions are usually made in the absence of extensive hydrometeorological records. A method is proposed for the sizing of small hydropower facilities which is based on the estimated flow duration curve, and its uncertainty. The flow duration curve is derived using an estimate of the mean annual runoff based on a climatalogical water balance with occasional instantaneous low flow measurements. This initial estimate can subsequently be augmented using stream gauge observations, and information transfer from a long-term stream gauge record. The hydropower generation facility sizing is based on the estimated flow duration curve, and its estimated uncertainty.

1305 Economics And Management

REFER ALSO TO CITATION(S) 13050022746

22509 **(DOE/R3/06079—T1) Flow-through hydroelectric power. Final report.** Maxfield, W.F. (Maxfield (William F.), Southampton, PA (USA)). 28 May 1983. Contract FG43-79R306079. 74p. NTIS, PC A04. File Number DE85009170.

There is a lot of untapped renewable hydroelectric generating power in the 1/2 kW to 20 kW range. The best use of up to 1 kW of power generation would be for domestic water heating. The electricity generated would have no connection to the existing electric service and would be used for resistance heating only. A simple thermostat for overheat protection in a standard water storage tank with a resistance heater insert in the tank would complete the generator installation. From 1-1/2 kW to 5 kW of generating power would best be used for a residential installation with an inverter to connect into the existing power system. The excess power generated would be fed into the power grid. The power sold to the utility would pay back the cost of the inverter and controls in 2 to 3 years. From 5-1/2 kW to 20 kW of generating power would be sufficient for a small group of houses with connection into the utility grid at a single transformer. Individual house electric meters would register the amount used at each house. Two electric meters at the transformer would register the amount used from the grid and the amount fed to the grid. This would make accurate billing possible.

22510 **(DOE/R3/08069—T1) Frostburg hydropower feasibility study. Final report.** (Frostburg, City of, MD (USA)). Sep 1982. Contract FG43-81R308069. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009161.

The City of Frostburg obtains its water supply from two sources: an impounded reservoir on Piney Creek and a series of springs. Both sources are located on the other side of Big Savage Mountain from the City and the water treatment works. Water from both sources is pumped to the top of the mountain via two pipelines and then flows by gravity to the raw water storage reservoir and then to the water treatment plant. The purpose of this study is to assess the feasibility of recovering hydropower from the 0.85 MGD (1.3 cfs) average flow in the pipeline as it falls approximately 500 feet from the top of the mountain to the water treatment plant. Steps in this analysis have included field and laboratory testing of the pipeline for head loss and strength characteristics, discussions with the local electrical utility (The Potomac Edison Company) regarding technical interconnection requirements and purchase rates, and correspondence with several hydro-electric generation equipment manufacturers.

22511 **(PB—85-142750/XAB) Small Hydro Power (SHP) Bulletin No. 1.** (United Nations Industrial Development Organization, Vienna (Austria)). 15 May 1984. 32p. NTIS, PC E04/MF E01.

Information is given on development of small-scale hydroelectric power generation in developing countries. It covers (1) news regarding institutional framework; ESCAP network and the regional development center in Hangzhou, China (2) SHP activities in eleven countries (3) international cooperation (4) innovations and advanced technology in SHP reported from USA (5) past and planned training programmes.

1306 Environmental Aspects

22512 **(DOE/BP—408) Annual review of BPA-funded fish and wildlife projects in Montana, November 28-29, 1984.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). 1985. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009670.

Brief summaries of projects investigating the impacts of hydroelectric power projects in Montana on fish and wildlife values are presented. (ACR)

22513 **(DOE/ID/12128—T1) Jackson Bluff Hydroelectric Project: emergency action plan, City of Tallahassee.** (Tallahassee, City of, FL (USA)). May 1984. Contract FC07-80ID12128. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008027.

Jackson Bluff Dam is located on the Ochlockonee River about 66 miles upstream from its mouth at the Gulf of Mexico and approximately 20 miles west-southwest of the City of Tallahassee. The site is situated in Leon, Gadsden, and Liberty counties. The dam consists of a 3600 ft long earth embankment with the crest at EL. 77 (MSL). About 1000 ft north of the end of the main dam is a saddle dam. The saddle dam is approximately 550 ft long and has crest at EL 72.3 (4.7 ft below the main dam). The gated spillway and the powerhouse are located at the southeast end of the dam. The purpose of the Emergency Action Plan is to specify actions to be taken in the event of flooding of the downstream of the Ochlockonee River due to failure of the dam.

22514 **Effects of dewatering on chinook salmon redds: tolerance of four development phases to one-time dewatering.** Becker, C.D.; Neitzel, D.A.; Abernethy, C.S. (Pacific Northwest Lab., Richland, WA). *North American Journal of Fisheries Management;* 3: 373-382(1983). Contract AC06-76RL01830.

Four intergravel development phases of chinook salmon Oncorhynchus tshawytscha were experimentally dewatered in artificial redds. The redds consisted of aquaria filled with a gravel mix and supplied with 4 liters of water per minute at 10 C. Cleavage eggs and embryos (the egg phases) and eleutheroembryos and pre-emergent alevins (the alevin phases) were each dewatered once for a continuous period. Egg phases were considerably more tolerant than alevin phases. Cleavage eggs tolerated one-time dewaterings up to 12 consecutive days (98% survival), the maximum exposure period. Embryos had similar tolerance when dewatered 12 consecutive days (92% survival), but survival declined to 64% and 53% when embryos were dewatered 16 and 20 consecutive days, respectively. Loss of embryos after the longer dewatering was associated with premature hatch. In contrast, eleutheroembryos tolerated only a 6-hour dewatering period (96% survival) and underwent high mortality when dewatered 48 consecutive hours. Pre-emergent alevins underwent near total mortality when dewatered 6 consecutive hours. Loss of alevin phases was associated with development of functional gill structures. 23 references, 3 figures.

1307 Power Conversion Systems

22515 **(DOE/R3/06116—T1) Telemetering equipment power generation study. Final technical report.** (Dewberry, Nealon and Davis, Pulaski, VA (USA)). 26 Sep 1980. Contract FG43-79R306116. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009242.

The purpose of this study was to examine the feasibility, both economic and technical, of operating a small hydro-electric generator installation to power an early flood warning system on the water storage reservoir for the Town of Big Stone Gap, Virginia. Such an installation would be used to charge batteries which in turn power a radio transmitter. The transmitter would convey status of the water reservoir level to a central flood monitoring point in the Town. While such a facility is normal engineering practice and would not justify a special study, the key element that differs from normal practice in this application is the use of a pump operating as a turbine rather than the use of a specially constructed turbine. This investigation concerns itself with the technical and economic aspects of operating a standard type of centrifugal pump as a turbine for the generation of power.

14 SOLAR ENERGY

1401 Resources And Availability

22516 **(AD-A—148096/1/XAB) Operational Tactical Decision Aid (OTDA) for infrared (8-12 micrometers) systems - Mark II Manual Version. Volume 3. Appendix B. Insolation and sky radiation tables. Technical report.** Hodges, D.B. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electronic and Information Sector Labs.). 30 Sep 1983. 334p. NTIS, PC A15/MF A01.

See also Volume 4, AD-B087 502L.

Tables are presented for determining solar irradiance and sky radiation values needed to calculate maximum lock-on range (MLOR) and maximum acquisition range (AR) from the Manual Version of the IR OTDA. A table for use in determining solar irradiance as a function of terrain elevation is also presented. Errors in computed sea level values of sky radiation as a function of terrain elevation are discussed and found to be small.

22517 **(DOE/BP/24574—1) Pacific Northwest solar radiation data.** (Oregon Univ., Eugene (USA). Solar Radiation Monitoring Lab.). 1 Apr 1985. Contract AC79-81BP24574. 221p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85009773.

A brief historical sketch is first presented outlining the establishment of the monitoring network and detailing some of the motivation for creating the network. The data analysis procedures are then outlined showing what happens once the data is received and explaining the checks made to ensure the accuracy of the data. Next the calibration of the sensors is discussed. Calibration of the instruments is essential in maintaining the accuracy of the data. The importance of char records is stressed in the following section. Then a few of the important results obtained from our analysis of the data are described, including comparisons with other sites and frequency distributions. In the next section we look at the possible effect on the data of the volcanic eruption of El Chichon in Mexico and discuss the possible effects of El Nino on the 1983 data. The last section before the data concerns empirical correlations determined for the Pacific Northwest. These correlations are used as the first step to determine the amount of solar radiation on a tilted surface. The data are presented in two sections. The first section contains monthly averaged data for all the sites. The monthly averaged data are given in two forms. First the hourly data for each month are averaged over the number of years for which the data are available. Then the average daily value for the month is given for each month in the data set. The overall monthly averaged daily value is also given in the same table. The last section contains a listing of all the daily solar radiation values collected by the UO network.

22518 **(FRNC-TH—1617) Multidimensional analysis of meteorological data and classification in "typical days" for five French stations. Application to the transposition of a solar heating system.** Choukour, M. (Universite de Technologie de Compiegne, 60 (France)). Jan 1982. 253p. (In French). NTIS (US Sales Only), PC A12. File Number DE85751004.

Climate data collected at the Carpentras, La Rochelle, Strasbourg, Trappes and Saint-Quentin stations are analysed. Detailed classifications according to the weather types recorded by each station are presented. One studies and then compares the adaptation of a solar heating system for several sites. A particular control and a simplified controlling device of the system combining air type collectors and a gravel bed storage are developed. The system profit-

ability is studied in various economic models. A comparison of savings achieved in the different regions is finally presented.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 14040022481

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 14050022479, 22480, 22481, 22482, 22484, 22485, 22486, 22487, 22488, 22489, 22491, 22493, 22494, 22495, 22496, 22497, 22500, 22506, 22558, 22819, 23123, 23135

22519 (CONF-8411158—1) Mulching improves the growth and internal moisture status of loblolly pine and yellow-poplar in an intensively managed biomass plantation. Walker, R.F.; Luxmoore, R.J.; McLaughlin, S.B. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008187.

From 3. biennial southern silvicultural research conference; Atlanta, GA, USA (7 Nov 1984).

The effects of mulching, in conjunction with fertilization and induced mycorrhizal symbioses, on the growth and internal moisture status of loblolly pine (Pinus taeda) and yellow-poplar (Liriodendron tulipifera) were studied in a plantation managed for the enhanced production of woody biomass. Mulching with perforated black plastic during the third growing season resulted in an increase in soil water potential, measured tensiometrically, which subsequently resulted in an increase in the xylem pressure potential, as measured by the pressure chamber technique, and the growth of these species. Four applications of urea-N annually at the rate of 25 kg ha^{-1} $application^{-1}$ during the second, third, and fourth year following planting resulted in a significant increase in the growth of both the loblolly pine and the yellow-poplar, but the loss of the integrity of the mycorrhizal treatments in this study negated an effort to assess the response of these species to induced mycorrhizal associations. 16 references, 2 tables.

22520 (DOE/ER/45070—1) Drift mobilities by time-of-flight methods and time-dependent phototransport in the nanosecond regime in amorphous semiconductors. Annual report, May 1, 1984-April 30, 1985. Paul, W. (Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences). Mar 1985. Contract FG02-84ER45070. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008729.

The purpose of this work is to elucidate transient phototransport and related phenomena in amorphous semiconductors, which have a bearing on the steady-state photoelectronic properties and the underlying electronic band structure. The approach has been to produce samples of a-Si:H and a-Si:H:F, to characterize them very well chemically, structurally and optically, and then to study the dispersive transport by the time-of-flight technique. This gives information on the mode of transport in these disordered substances. By studying the collected charge versus applied electric field on intrinsic and doped samples, one is also able to obtain information on the electron and hole lifetimes for deep trapping as a function of the position of the Fermi level, and thereby on the energetic position of the neutral and negatively-charged dangling bond states and on the modifications to the density-of-states in the conduction and valence band tails by the various dopants. These results are important both for fundamental understanding of this class of semiconductors and for improvement of devices based on them for solar cell and thin film transistor applications.

22521 (DOE/ET/23197—T11) Semicrystalline casting process development and verification. Final report, June 19, 1980-February 28, 1984. (Solarex Corp., Rockville, MD (USA)). 1984. Contract FC01-80ET23197. 339p. NTIS, PC A15/MF A01; GPO Dep. File Number DE85007695.

It has been shown that the Ubiquitous Crystallization Process is a viable technology for the high volume production of semicrystalline sheet material. Engineering aspects leading to the demonstration of technology feasibility are dealt with, followed by a description of the fundamental research carried out in an effort to gain a basic understanding of the mechanisms influencing the electrical and material properties of polycrystalline silicon. Economic analyses, high temperature systems development, performance analysis, and wafering and sizing systems development are discussed. Basic research efforts include mechanisms limiting solar cell performance, mechanisms impacting yield and productivity, and material evaluation techniques. (LEW)

22522 (DOE/JPL/956679—84/5) MOD silver metallization for photovoltaics. Quarterly technical report, December 1, 1984-February 28, 1985. Vest, G.M.; Vest, R.W. (Purdue Research Foundation, Lafayette, IN (USA)). 20 Mar 1985. Contract NAS-7-100-956679. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009809.

The specific technological objectives of the current program are to identify and characterize suitable metallo-organic (MO) compounds, develop generic synthesis procedures for the MO compounds, develop generic fabrication procedures for screen printable metallo-organic decomposition (MOD) silver inks, and optimize processing conditions to produce grid patterns on photovoltaic cells. The metallizations will be evaluated as to their appearance, line definition, adhesion, sheet resistance and microstructure. The metallized cells will be evaluated at JPL as to their performance as solar cells, although initial photovoltaic evaluation will be done at Purdue. Once a suitable MOD silver ink or inks have been developed a small weight percent (<5 w/o) of a suitable platinum MO compound will be added to give the ink good solder leach resistance which silver films alone do not possess. The platinum addition will also allow for quantitative adhesion data to be collected. Other additives in the form of MO compounds may also be used should a permanent binding agent be deemed necessary. Once a final ink composition is selected, the metallizations adhesion and sheet resistance will be evaluated after thermal aging. Another objective of the program is to develop a model which describes the adhesion between the fired silver film and the silicon surface.

22523 (DOE/JPL/956831—3) Pulsed excimer laser processing for cost-effective solar cells. Quarterly report No. 3, November 1984-January 1985. Wong, D. (ARCO Solar, Inc., Chatsworth, CA (USA)). 1985. Contract NAS-7-100-956831. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009651.

Residual lattice damage by 5 keV ion implantation as well as surface flaws induced by wafer cleaning have been proven to affect the V/sub oc/ more adversely for laser-annealed cells than conventional thermal-diffusion. However, an alternative, molecular implantation of molecular species holds potential. The first experimental results are encouraging, although further investigation and tests would be required. The lack of a commerically available mass-analyzed implantation with low energy, high fluence ions is constraining.

22524 (DOE/R3/06063—T1) Feasibility study of reed, Phragmites australis, biomass energy conversion. Drifmeyer, J.E. (Bio-Test Systems, Inc., Edgewood, MD (USA)). [1980]. Contract FG43-79R306063. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008988.

Phragmites is a widely distributed, highly productive grass occupying a variety of habitats in the Region III Atlantic Coastal Plain. Information, largely from the foreign literature, suggests that seasonal nutrient cycles within the plant, as well as changes in the plant's composition between terrestrial and aquatic habitats may be important influences on the nutritional value and palatibility of Phragmites to consuming organisms. Although direct grazing of Phragmites is apparently quite limited, the plant seems to be an important contributor to detrital food webs in aquatic habitats. It is precisely these characteristics of the Phragmites habitat (internal nutrient recycling and limited wildlife value on terrestrial sites) that, along with its record productivity, makes this plant an almost ideal candidate species for biomass harvesting and energy conversion.

22525 **(FRNC-TH—1706) Preparation and characterization of the positive contact of $pCu_2S/nCdS$ solar cell. Contribution to the characterization and study under constraints of the cell.** Dhouib, A. (Montpellier-2 Univ., 34 (France)). Oct 1982. 250p. (In French). NTIS (US Sales Only), PC A11. File Number DE85751008.

The principal stages in manufacture and results of characterization taking the mercury as back electrode are recalled. Development tests of different types of rear contact are presented. Then, one deals with the characterizations used for the choice of the electrode taking account of the photovoltaic results obtained and impurities of the various layers which they involve. The choice of an encapsulent on moisture seal criteria and the ease of characterizing encapsulated cells, and their behavior under thermal stresses in darkness are studied.

22526 **(HNEI—84-S02) Energy cane as a multiple-products alternative.** Alexander, A.G. (Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station). 1984. 27p. (CONF-8411159—1). NTIS, PC A03/MF A01. File Number DE85901276.

From Pacific Basin biofuel workshop; Honolulu, HI, USA (1 Nov 1984).

CANE SUGAR planting as it was formerly known is in serious and essentially irreversible trouble. Diversification of sugarcane to alternative farm crops is indicated in some instances. Yet, for the most part, the more logical alternative is an internal diversification to a multiple-products biomass commodity. Sometimes termed the energy cane approach, its keystones are the management of sugarcane as a quantitative rather than qualitative entity, and the inclusion of certain tropical-grass relatives to assist cane in its year-round supply of biomass to industrial consumers. Managed in this way, absolute tonnages of whole cane are increased materially beyond what is possible from sugar-crop management. Juice quality declines but sugar yields are significant as a function of high biomass tonnages per acre. Usage of the lignocellulose can range from low-quality humid boiler fuel in furnaces designed for refuse incineration, to higher-quality fuels in more efficient boilers, to proprietary fuels and chemical products, and to lignocellulose supply as the feedstock for primary chemicals production. The latter might include, for example, synthesis gas and petrochemicals in tropical regions lacking natural gas, naphtha, or coal as starting materials. Diversification of sugarcane to completely new farm commodities is opposed in favor of internal diversification to a high-growth, multiple-products commodity. Decisive issues here are as much educational as they are technical. The energy cane concept maintains that sugarcane is a future resource of enormous national and international value. It should develop accordingly where decision-taking is by persons who respect the cane plant and who have done their homework on its alternative-use potentials. 35 references, 5 figures, 6 tables.

22527 **(N—85-10446) Process Research of Polycrystalline Silicon Material (PROPSM).** Culik, J.S. (Solarex Corp., Rockville, MD (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1983. 19p. (NASA-CR—173838; JPL—9950-935). NTIS, PC A02/MF A01.

Recent reported results of hydrogen-passivated polycrystalline silicon solar cells are summarized. Most of the studies have been performed on very small grain or short minority-carrier diffusion length silicon. Hydrogenated solar cells fabricated from this material appear to have effective minority-carrier diffusion lengths that are still not very long, as shown by the open-circuit voltages of passivated cells that are still significantly less than those of single-crystal solar cells. The short-circuit current of solar cells fabricated from large-grain cast polycrystalline silicon is nearly equivalent to that of single-crystal cells, which indicates long bulk monitority-carrier diffusion length. However, the open-circuit voltage, which is sensitive to grain boundary recombinaton, is 20 to 40 mV less. The goal of this program is to minimize the variations in open-circuit voltage and fill-factor that are caused by structural defects by passivating these defects using a hydrogenation process.

22528 **(N—85-11133) Effect of plasma on solar cell array arc characteristics.** Snyder, D.B.; Tyree, E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 17p. (NASA-TM—86887; E—2351; CONF-850136—6). NTIS, PC A02/MF A01.

From 23. AIAA aerospace sciences meeting; Reno, NV, USA (14 Jan 1985).

The influence from the ambient plasma on the arc characteristics of a negatively biased solar cell array was investigated. The arc characteristics examined were the peak current during an arc, the decay time as the arc terminates, and the charge lost during the arc. These arc characteristics were examined in a nitrogen plasma with charge densities ranging from 15,000 to 45,000 cu cm. Background gas pressures ranged from 8x1,000,000 to 6x100,000 torr. Over these ranges of parameters no significant effect on the arc characteristics were seen. Arc characteristics were also examined for three gas species: helium, nitrogen and argon. The helium arcs have higher peak currents and shorter decay times than nitrogen and argon arcs. There are slight differences in the arc characteristics between nitrogen and argon. These differences may be caused by the differences in mass of the respective species. Also, evidence is presented for an electron emission mechanism appearing as a precursor to solar array arcs. Occassionally the plasma generator could be turned off, and currents could still be detected in the vacuum system. When these currents are presented, arcs may occur.

22529 **(N—85-11457) Research on gallium arsenide diffused junction solar cells. Final report, 1 October 1982-30 June 1984.** Borrego, J.M.; Ghandi, S.K. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Oct 1984. 54p. (NASA-CR—174057). NTIS, PC A04/MF A01.

The feasibility of using bulk GaAs for the fabrication of diffused junction solar cells was determined. The effects of thermal processing of GaAs was studied, and the quality of starting bulk GaAs for this purpose was assessed. These cells are to be made by open tube diffusion techniques, and are to be tested for photovoltaic response under AMO conditions.

22530 **(PB—85-125862/XAB) Volume and biomass for curlleaf cercocarpus in Nevada. Research paper.** Chojnacky, D.C. (Forest Service, Ogden, UT (USA). Intermountain Forest and Range Experiment Station). Nov 1984. 14p. NTIS, PC A02/MF A01.

Volume and biomass equations were developed for curlleaf cercocarpus (Cercocarpus ledifolius) in the Egan and Schell Mountains near Ely, NV. The equations predict cubic foot volume of wood and bark for variable minimum branch diameters. Wood density factors are given to convert volume predictions to pounds of fiber biomass. The reliability of the equations was assessed using the jackknife technique to construct confidence intervals.

22531 **(PB—85-140176/XAB) Ethanol from sugar crops: a critical review.** Lipinsky, E.S.; Allen, B.R.; Bose, A.; Kresovich, S. (Battelle Columbus Labs., OH (USA)). Jan 1981. 109p. NTIS, PC A06/MF A01.

Due to the hardships resulting from rising oil prices and periodic production shortfalls, many developing countries, especially those with warm humid climates, have explored ethanol production from sugar crops. This critical review offers information on ethanol production for development planners. Two sugar crop-based ethanol systems, raw sugar facility retrofit and conventional juice extraction, are first examined. The agronomy of sugar crops (cane, beet, sorghum) is then described, as are the steps in crop processing (extraction, fermentation, distillation, stillage disposal). The costs of producing ethanol from a typical sugarcane processing plant and from a state-of-the-art molasses processing facility are presented, and the trade-offs between producing ethanol or raw sugar from sugarcane weighed. Finally, the properties of ethanol in automotive fuels are outlined, along with important storage, handling, and safety considerations. Three major problems are cited in ethanol production from sugar crops: adverse environmental effects (10 gallons of waste to 1 gallon of ethanol); the high cost of conventional milling equipment; and the loss of potential revenue from raw sugar sales. A future possibility of producing ethanol from fi-

brous residues (bagasse) is noted. Included are a 64-item bibliography (1936-1980) and 31 tables.

22532 (SAND—84-2663C) **Strained-Layer-Superlattice optoelectronic devices.** Chaffin, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 9p. (CONF-850345—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009148.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

The Strained-Layer-Superlattice (SLS) is an important new class of semiconductor material. This new semiconductor material has many novel and tailorable properties that can be used to make new or improved optoelectronic (OE) devices. At Sandia National Laboratories we have fabricated and tested Light-Emitting-Diodes (LED's), Lasers, Detectors and other OE SLS devices. Data is presented on these devices. Novel infrared and photovoltaic device concepts are also described.

22533 (SAND—84-7020) **Development of a second-generation linear Fresnel lens photovoltaic and thermal (PVT) concentrator array, including fabrication and installation of a 200 square meter collector field.** O'Neill, M.J. (Entech, Inc., Dallas-Fort Worth Airport, TX (USA)). Feb 1985. Contract AC04-76DP00789. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85008473.

This report summarizes work performed in two areas: development of a second-generation linear Fresnel lens photovoltaic concentrator array, and development and fabrication of a 22 kilowatt photovoltaic and thermal concentrator array. Under these programs, ENTECH, Inc. developed a new second-generation linear Fresnel lens PVT concentrator system, and deployed a 200 square meter collector field of the new design at Sandia-Albuquerque. The new system combines excellent performance and low mass-production cost.

22534 (SAND—84-7024) **Improving the performance of current baseline concentrating PV converters.** Hardee, P.C.; Marshall, L.S. (Martin Marietta Corp., Denver, CO (USA). Denver Aerospace). Feb 1985. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011079.

An evaluation for possible improvements to the Martin Marietta second generation photovoltaic concentrator array design determined that the use of smaller PV cells with secondary optical elements presented the greatest potential improvement in the design of the system. Design modifications were generated that included the design of a secondary optical element to replace the guardband provided in the original design through the use of oversized cells. Materials were procured and three modules fabricated based on the modified design. These modules have been transferred to Sandia National Laboratories for performance testing and evaluation.

22535 **Effect of recombination on the open-circuit voltage of a silicon solar cell.** von Roos, O.; Landsberg, P.T. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91109). *Journal of Applied Physics;* 57: No. 10, 4746-4751(15 May 1985).

A theoretical study of the influence of band-band Auger, band-trap Auger, and the ordinary Shockley—Read—Hall mechanism for carrier recombination on the open-circuit voltage V/sub OC/ of a solar cell is presented. Under reasonable assumptions for the magnitude of rate constants and realistic values for trap densities, surface recombination velocities and band-gap narrowing, we find the maximum V/sub OC/ for typical back surface field solar cells to lie in the range between 0.61 and 0.72 V independent of base width.

22536 **X-ray photoelectron and Auger electron spectroscopic analysis of surface treatments and electrochemical decomposition of $CuInSe_2$ photoelectrodes.** Cahen, D.; Ireland, P.J.; Kazmerski, L.L.; Thiel, F.A. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* 57: No. 10, 4761-4771(15 May 1985).

$CuInSe_2$ photoanodes can be optimized for use in electrochemical photovoltaic cells, containing aqueous polyiodide as the electrolyte, by wet chemical etching in Br_2MeOH and subsequent thermal treatment (air oxidation). Surface analyses show the formation of a rather clean, Cu-depleted surface with some adsorbed oxygen after Br_2/MeOH etch, and the formation of indium-oxygen bonds after thermal treatment, in accordance with previous studies that show indium oxides to be the native ones on this semiconductor. Samples that underwent photoanodic decomposition in the iodide electrolyte and those that were purposely decomposed in acetonitrile showed severe to near-total Cu depletion near their surface and the presence of lower valent Se. These data complement those from solution analyses and from electrochemical studies, to characterize the preferred decomposition path of $CuInSe_2$ sufficiently to stabilize this type of photoelectrochemical cell. Our conclusions are based on the use of Auger parameters and, to a lesser extent, on empirical comparison of x-ray induced Auger electron line shapes, because of the difficulty in extracting unambiguous conclusions from x-ray photoelectron binding energies only.

22537 **Transit time studies of junction location in thin-film solar cells.** Ahrenkiel, R.K.; Matson, R.J. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* 46: No. 9, 877-879(1 May 1985). Contract AC02-83CH10093.

The active junction in Cd(Zn)S/$CuInSe_2$ thin-film solar cells was investigated by a pulse photoconductivity technique. We observed the diffusion transit time of minority carriers to a homojunction internal to the $CuInSe_2$. No electrical activity at the heterojunction was indicated.

22538 **Solar cells with low cost substrates and process of making same.** Mitchell, K.W. (to Dept. of Energy). US Patent 4,482,780. 13 Nov 1984. Filed date 30 Nov 1982. vp. PAT-APPL-445772.

A solar cell having a substrate and an intermediate recrystallized film and a semiconductor material capable of absorbing light with the substrate being selected from one of a synthetic organic resin, graphite, glass and a crystalline material having a grain size less than about 1 micron². The intermediate recrystallized film has a grain size in the range of from about 10 microns² to about 10,000 microns² and a lattice mismatch with the semiconductor material not greater than about 4%. The semiconductor material has a grain size not less than about 10 microns². An anti-reflective layer and electrical contact means are provided. Also disclosed is a subcombination of substrate, intermediate recrystallized film and semiconductor material. Also, methods of formulating the solar cell and subcombination are disclosed.

22539 **The importance of surface texture to high silicon solar cell performance.** Spitzer, M.B.; Bajgar, C.; Keavney, C.J.; Tobin, S.P. (Spire Corporation, Bedford, MA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2092-2097(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

This paper reviews the utilization of surface texture for attainment of high conversion efficiency in Si p/n junction solar cells. Advantages and disadvantages of surface texture are discussed, and recent research on high efficiency ion-implanted cells that demonstrates some important aspects of texture is reviewed. Texture-etched cells with AMI conversion efficiency of 18% are reported and the manner in which use of texture might lead to even higher efficiency is discussed.

22540 **Terrestrial photovoltaic collector technology trend.** Shimada, K.; Costogue, E. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 2: 2183-2189(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Following the path of space PV collector development in its early stages, terrestrial PV technologies based upon single-crystal silicon have matured rapidly. Currently, terrestrial PV cells with efficiencies approaching space cell efficiencies are being fabricated into modules at a fraction of the space PV module cost. New materials, including $CuInSe_2$ and amorphous silicon, are being devel-

oped for lowering the cost, and multijunction materials for achieving higher efficiency. Large grid-interactive, tracking flat-plate power systems and concentrator PV systems totaling about 10 MW, are already in operation. Collector technology development both flat-plate and concentrator, will continue under an extensive government and private industry partnership.

22541 **Concentrator cell status and projections.** Arvizu, D.E. (Concentrator Photovoltaic Technology, Sandia National Laboratories, Albuquerque, New Mexico). *Proceedings, Intersociety Energy Conversion Engineering Conference;* **4**: 2128-2136(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Over the last few years much work has been directed at improving conventional single crystal silicon cells for concentrator application. Although 20% efficient concentrator cells have been fabricated, the current thinking indicates that conventional silicon devices are approaching theoretical maximums. The primary emphasis of today's Federal program for concentrating photovoltaics is directed at advanced high efficiency devices. Advanced device approaches that are being pursued include patterned diffusion silicon designs with practical efficiency limits greater than 25%, optimized conventional GaAs devices with efficiency limits near 28%, and multiple-junction structures with efficiency limits over 35%. Progress in each of these areas are reviewed.

22542 **Status of high efficiency module design and fabrication.** Nowlan, M.J.; Spitzer, M.B. (Spire Corporation, Bedford, MA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* **4**: 2177-2182(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

The Department of Energy Five Year Plan calls for AMI module efficiency of 15% at normal operating temperature by 1988. To achieve this goal, research is underway at Spire to increase cell efficiency, improve module design, and reduce module operating temperature. In addition, development of low-cost fabrication processes and equipment are being pursued. This paper presents a review of these ongoing programs and indicates manufacturing trends leading to attainment of the DOE goals.

22543 **Recent improvements in materials for thin GaAs and multibandgap solar cells.** Benner, J.P. (Solar Energy Res. Inst., Golden, CO). *Proceedings, Intersociety Energy Conversion Engineering Conference;* **1**: 212-215(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

The High Efficiency Concepts Program at SERI supports research on III-V compound semiconductors with the objective of achieving the maximum attainable photovoltaic conversion efficiencies for terrestrial solar electric power. The outcome of this research may also effect the future of space photovoltaic cells. While the interest in thin-film, high-efficiency solar cells for terrestrial applications is driven principally by consideration of system costs, such cells would also improve the power density of space power arrays.

22544 **Effect of silane fraction on the optoelectronic and photovoltaic properties of RF glow discharge a-Si:H prepared from SiH_4 + H_2 mixtures.** Rajeswaran, G.; Vanier, P.E.; Kampas, F.J.; Corderman, R.R. (Brookhaven National Lab., Upton, NY). *Journal of Non-Crystalline Solids;* **59-60**: 1131-1134(Dec 1983).

The properties of films grown from SiH_4 + H_2 mixtures were systematically investigated. The hydrogen content, band gap, dark conductivity, and photoconductivity were measured as a function of SiH_4 fraction. Solar cells were fabricated from 10% and 25% mixtures. 6 references, 6 figures.

22545 **Photochemical energy conversion by a thiazine photosynthetic-photoelectrochemical cell.** Pan, R.L.; Bhardwaj, R.; Gross, E.L. (Ohio State Univ., Columbus). *Journal of Chemical Technology and Biotechnology;* **33A**: 39-48(1983).

A thiazine photoelectrochemical cell has been developed involving thiazine photoreduction using EDTA as the electron donor together with photosynthetic electron transport in chloroplasts to generate electricity with a higher power conversion efficiency than for thiazine-EDTA alone. Thionine and methylene blue have been shown to be electron acceptors of Photosystem I. The cell employed had a high ratio of the area of chloroplast-impregnated membrane compared to the volume of thiazine solution. This emphasized the photoosynthetic contribution. These results show that the thiazine photogalvanic cell can be combined with the chloroplast solar battery in order to increase the power conversion efficiency of the system.

22546 **Photosynthetic photoelectrochemical cell using flavin mononucleotide as the electron acceptor.** Pan, R.L.; Fan, I.J.; Bhardwaj, R.; Gross, E.L. (Ohio State Univ., Columbus). *Photochemistry and Photobiology;* **35**: 655-664(1982). Contract FG02-79ER10538.

The authors have been developing a solar cell using the photochemistry of photosystem I particles and flavin mononucleotide. They have studied the effect of changing various parameters including the nature of the electron donor, its redox poise, the pH of the medium and the salt concentration. The maximum power conversion efficiency was 1%. Several light-dark cycles could be observed. One of the important properties of this cell is that it can store energy in the form of chemical potential.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 14060022543

22547 **(DOE/ET/20624—T11) Airport Solor Photovoltaic Concentrator: Phase III. Project status report No. ASPCP III-11, October 1-December 31, 1984.** (Arizona Public Service Co., Phoenix (USA)). 1985. Contract AC04-80ET20624. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85006773.

The objective of the work reported is to operate and evaluate for three years a photovoltaic system installed at an airport. The system consists of an 80-array subsystem with a nominal rating of 225 peak kilowatts dc output at the array field. Installation of a new inverter is reported. A fire was caused by an electrical short to ground inside one of the solar cell modules and began spreading throughout one of the arrays, causing extensive damage. Fuses were installed in series with the blocking diodes to prevent high reverse currents. (LEW)

22548 **(DOE/ET/20626—T1) Fabrication, installation, and two-year evaluation of a 245 square meter linear Fresnel lens photovoltaic and thermal (PVT) concentrator system at Dallas/Ft. Worth (DFW) Airport, Texas. Final technical report, Phase II and Phase III.** O'Neill, M.J.; Muzzy, D.B. (Entech, Inc., Dallas-Fort Worth Airport, TX (USA)). Feb 1985. Contract AC04-79ET20626. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85008188.

This final technical report summarizes the results of the fabrication, installation, and two-year evaluation of the first linear Fresnel lens photovoltaic and thermal (PVT) concentrator system ever deployed. The system is located on the Central Utility Plant at DFW Airport, Texas. The roof-mounted collector field provides 245 square meters of sun-tracking collector aperture area. The nominal 25 kilowatt peak electrical output of the system is used for plant lighting, while the nominal 120 kilowatt peak thermal output is used to preheat domestic water for the nearby AMFAC hotel. The system has performed efficiently and reliably over the full two-year operational period. Long-term system conversion efficiencies have been 7.7% sunlight-to-electricity, 39.1% sunlight-to-heat, 46.8% sunlight-to-total energy output. Each of these efficiency levels is thought to be the highest ever achieved by a commercial-scale photovoltaic system. System durability has also been excellent, with no detectable degradation in performance over the full operational period. In summary, this successful application experiment has verified the potential of the linear Frenel lens PVT system to reliably and efficiently deliver electricity and heat in commercial-scale applications.

22549 **(SAND—83-7025) Photovoltaic system grounding and fault protection guidelines.** (Bechtel Group, Inc., San Francisco, CA (USA)). Feb 1985. Contract AC04-76DP00789. 447p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85009870.

This document addresses grounding and fault protection aspects of photovoltaic power systems. It is intended to serve as a reference for system designers and others working with photovoltaics. The emphasis is on large systems, such as central stations (>1 MW), with commercial and industrial-sized systems (20 kW to 1 MW) also addressed. Design criteria and requirements are presented for grounding and fault protection subsystems. Details of grounding subsystems are discussed in terms of subsystem configurations, integration with other subsystems, the use of foundations as ground electrodes, corrosion, and other factors. Fault protection details include representative configurations, fault detection alternatives and economics, power conditioning aspects, protection against nearby lightning strikes, and other factors. Transformerless power conditioners and isolation transformers are discussed for commercial/industrial applications. Appendices include representative lists of suppliers of relevant equipment and equations for the resistance to earth of various electrode configurations.

22550 **(SAND—84-1755) Photovoltaic Systems Development Project: an activity summary.** Post, H.N.; Jones, G.J.; Key, T.S.; Stevens, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1985. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009994.

The Photovoltaic Systems Development Project has as its principal goal the development of optimum system configurations for all photovoltaic applications. Since its inception in 1978, this project has been involved in a variety of activities including system design studies, subsystem requirement definition, hardware development, and prototype testing which have brought us closer to realizing this goal. The purpose of this document is to provide a summary of past findings and current activities within the Systems Development Project and to identify system issues which remain to be addressed. Key results developed through previous activities are identified, including references for the reader interested in additional detail. This presentation uses the format of the Photovoltaic Five Year Research Plan to show the relationship between the activities of this project and the other activities in the National Photovoltaic Program. Project plans and corresponding program impacts are presented and a major new activity, that of the System Design Assistance Center, is identified. It is anticipated that this activity, which will provide photovoltaic technology transfer to a variety of interested users/owners in the public, private and governmental sectors, will take on considerably more importance in the years to come.

22551 **Power conditioning for grid-connected P.V. systems less than 250 KW.** Key, T.S. (Sandia National Laboratories, Albuquerque, NM). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2197-2202(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Power conditioning development for grid-connected photovoltaic (PV) applications has been underway for the past five years at Sandia Laboratories. Although the dc source is a photovoltaic array, many of the advances and lessons-learned have general applicability to any dispersed generation source connected to the electric utility grid. Progress in single-phase (2-10 kW) and three-phase (20-250 kW) hardware are covered. Results from a detailed hardware evaluation program are reviewed. Cost and efficiency experience and future projections are summarized.

22552 **Potential applications of photovoltaic energy for pumping and desalting Australian groundwater using brushless DC motors.** Longrigg, P. (Solar Energy Res. Inst.). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2098-2102(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

This paper discusses methods and techniques for transporting and desalting groundwater supplies using the renewable energy derived from solar photovoltaic systems. The reliability of this type of equipment is emphasized, which operates in remote areas far from other power supplies and maintenance facilities. Until relatively recently, the cost of photovoltaic arrays in remote areas, compared with thermal methods of desalination, precluded their use. But recent developments in photovoltaic technology have changed this. The use of brushless dc motors directly coupled to the PV array eliminates the cost of inverter power conditioning required for ac induction motors. The PV/brushless dc motor configuration yields a particularly good technical fit for pumping and desalting groundwater in the Australian Outback.

22553 **Photovoltaic system overview.** Sutton, P.D. (Bechtel Power Corporation, Los Angeles, CA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2108-2112(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

This paper provides a brief overview of utility-connected photovoltaic energy systems. It begins by discussing the major elements of the photovoltaic system: the collector, the array field and the power conditioner. Each of these elements is described and the current status of technology development for each is reviewed. Then, the interconnection of these elements is discussed, including the impact of each subsystem's efficiency on system output. Finally, the issues of system cost and system energy value are discussed. The photovoltaic systems are shown to be simple, well-defined energy sources that have large potential within a geographically limited market.

22554 **Utility-interactive photovoltaic power conditioners: Effects of transformerless design and dc injection.** Das, R.; Klein, J.; Krauthamer, S. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2220-2225(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Many utility-interactive photovoltaic systems use isolation transformers in their power conditioning subsystems to eliminate dc injection into the utility. Isolation transformers are costly and reduce overall system efficiency. As a result, it would be desirable to eliminate them. System design impacts of a transformerless power conditioning subsystem that will eliminate dc injection and is safe is discussed. Advantages of and requirements for such a design are presented. A transformerless power conditioning subsystem can be developed that will eliminate concerns associated with the dc injection into a utility system.

22555 **Photovoltaic central-station power conditioner subsystems.** Krauthamer, S.; Bahrami, D.K.; Bulawka, A. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2203-2209(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

The potential of applying new advanced circuit topologies and semiconductors with improved switching characteristics to the design and development of central-station power conditioning subsystems is assessed. State-of-the-art large power conditioners suitable for photovoltaic central-station application are reviewed. Advanced topology power conditioning subsystems, when compared to available production hardware, promise improved performance, significant cost reduction, and lower cost-to-efficiency ratios.

22556 **Power conditioner subsystems -- DOE technology development status.** Bulawka, A.O. (U.S. Department of Energy, Washington, DC). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2190-2194(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

The philosophy and strategy for implementation of power conditioning systems research and development (R & D) within the National Photovoltaic Program's Five Year Research Plan (1984-

1988) is developed. Historical R&D evolution and past accomplishments are examined. Current activities and future opportunities are evaluated in pursuance of competitive energy to existing systems interfacing with the National Electric Utility Grid.

22557 **The future for residential photovoltaic systems.** Thomas, M.G.; Royal, G.C. (Sandia National Laboratories, Albuquerque, NM). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2140-2144(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Residential photovoltaic systems represent a huge potential market. Residential loads represent about one-third of the electrical use in the United States. With the anticipated reduction in module costs to the $2.00/W /SUB p/ level, and a building block approach described in this paper, no technical impediments remain for residential photovoltaics. Public acceptance of this alternate is, however, still an open question.

22558 **A comparative evaluation of new low-cost array field designs for grid-connected photovoltaic systems.** Post, H.N.; Noel, G.T. (Sandia National Laboratories, Albuquerque, NM). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2171-2176(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

New array field designs which have been developed to minimize the balanceof-system (BOS) cost for grid-connected photovoltaic (PV) systems are examined. Previous experience with intermediate-size systems experiments has shown the array field BOS to be a major cost contributor to PV systems, with BOS costs in the range of $5/W /SUB p/ and up. These new designs which are appropriate for both intermediate and large-size ground-mounted flat plate arrays have significantly reduced the BOS cost. Key features of the array field BOS components including structures, foundations, intermodule connection, field wiring, and system grounding are identified for each design. Cost projections as well as cost experience on prototype and full-scale installations are presented and compared. It is concluded that $0.50/W /SUB p/ for the array field BOS is achievable for large-size systems.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 14070022718

22559 **(DOE/AL/16333—1) Solar-parabolic dish-Stirling-engine-system module. Task 1: Topical report, market assessment/conceptual design.** (Advanco Corp., El Segundo, CA (USA)). 30 Nov 1982. Contract FC04-82AL16333. 209p. (ESG—82-41). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85009038.

The major activities reported are: a market study to identify an early market for a dish-Stirling module and assess its commercial potential; preparation of a conceptual system and subsystem design to address this market; and preparation of an early sales implementation plan. A study of the reliability of protection from the effects of walk-off, wherein the sun's image leaves the receiver if the dish is not tracking, is appended, along with an optical analysis and structural analysis. Also appended are the relationship between PURPA and solar thermal energy development and electric utility pricing rationale. (LEW)

22560 **(SAND—84-8189) Small Central Receiver Brayton Cycle Study. Final technical report, December 1, 1982-June 30, 1983.** (Boeing Aerospace Co., Seattle, WA (USA). Energy Systems). Jan 1985. Contract AC04-76DR00789. 271p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85008882.

The study was initiated to investigate the potential of small scale, central receiver Brayton cycle systems to provide simple, highly reliable, low-maintenance electrical generating systems. The objectives were to identify Brayton cycle configurations suited for high-reliability central receiver systems generating electricity in the 2- and 25-MW/sub e/ power ranges and to identify and recommend high-temperature receiver designs most appropriate to the preferred cycle configurations. The cycle configurations considered were open and closed cycles with and without regeneration and/or intercooling. The configurations were assessed in terms of required machine design modifications, component availability turbomachinery location, costs and performance. Design point performance was studied as a function of system pressure, turbine inlet temperature and receiver pressure loss. An open cycle regenerated and intercooled configuration was selected for the 25-MW/sub e/ plant size. At the 2-MW/sub e/ size, an open simple cycle was chosen. The high temperature receiver study involved the identification of heat exchange concepts, survey of high-temperature materials, and selection of preferred concepts. Thermal and mechanical design analyses were completed on the receiver concepts. The ceramic tube receiver concept was selected as the preferred concept for the 25-MW/sub e/ plant size. The small particle receiver concept was selected for the 2-MW/sub e/ plant size. The preferred receiver designs were combined with the preferred cycle data to produce system level designs. System performance and cost data were generated for each plant size. The results of this study show that small-scale, remotely-sited solar Brayton central receiver systems are technically feasible and economically attractive through the use of simple passive receiver designs and low-maintenance, high-reliability gas turbomachinery.

22561 **(SAND—85-8202) Department of Energy solar central receiver annual meeting: proceedings.** (Sandia National Labs., Livermore, CA (USA)). Feb 1985. Contract AC04-76DR00789. 255p. (CONF-8404139—). NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85009114.

From Solar central receiver annual meeting; San Diego, CA, USA (24 Apr 1984).

Separate abstracts were prepared for 24 papers in this proceedings. One other paper had been previously abstracted for EDB. (LEW)

22562 **Direct contact heat exchanger for phase change thermal storage.** Luft, W.; Leach, J.W.; Lowry, T. (Solar Energy Res. Inst., Golden, CO). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 2: 1164-1170(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

A molten salt-to-liquid metal direct contact heat exchanger is being developed for phase change thermal storage in central receiver solar thermal plants. The heat exchanger consists of a column of liquid metal into which molten salt is injected. Salt droplets that form at the injector orifices rise through the column and solidify as they transfer heat to the liquid metal. Initial experimental work to determine the heat exchanger performance limits is documented. Also, results of analyses to estimate costs for representative system designs are given.

22563 **Thermal energy storage at 900°C.** Copeland, R.J.; Kreith, F.; West, R.E. (Solar Energy Res. Inst., Golden, CO). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 2: 1171-1175(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

This paper presents a preliminary technical and economic analysis of various concepts for sensible heat storage at a temperature of 900°C. To make solar-thermal-energy systems, such as central receivers for power generation, viable, it is generally recognized that they must contain an energy storage subsystem. Copeland et al. have made preliminary cost estimates for some high-temperature molten salt storage concepts. This work suggests that molten carbonate salt storage may have economic potential in power-plant-scale systems. Some early concepts for molten salt containment, such as an internal metal honeycomb have not been feasible because of their high metal corrosion rates. Work is continuing at SERI to generate new molten salt containment concepts and to make preliminary economic and technical analyses to identify candidates for further research.

22564 **The solar molten salt electric experiment.** Holmes, J.T. (Sandia Nat. Lab., Albuquerque, NM). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1700-1703(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

For the first time a molten salt heat transfer working fluid is being used in an integrated system that uses sunlight to generate electricity. The capacity of the solar receiver is 5 MWt; the thermal storage capacity is 7 MWHt; the steam generator rating is 3 MWt; and the turbogenerator output is 0.75 MWe. This second generation solar power tower technology is a joint venture between the U.S. Department of Energy, electric utilities, and industry. Utility and industry teams will receive hands-on experience with operating this sytem later in 1984.

22565 **High temperature solar thermal energy absorption with solid particles.** Burolla, V.P.; Hurby, J.M.; Steele, B.R. (Sandia National Laboratories, Livermore, CA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1663-1668(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

In tests designed to simulate the fundamental characteristics of a solar thermal solid particle central receiver, a continuous stream of free-falling particles has been heated to temperatures in excess of 1300 K using a radiant flux of 0.50 MW/m^2. Particle temperatures were varied by altering the particle size, mass flow rate, optical properties and the radiant flux. Flux levels were varied between 0.24 and 0.50 MW/m^2, for particles with nominal diameters of 300 μ m 500 μm and 1000 μm.

1408 Ocean Energy Systems

22566 **(ANL/OTEC-PS—12) Temperature sensors for OTEC applications.** Seren, L.; Panchal, C.B.; Rote, D.M. (Argonne National Lab., IL (USA)). May 1984. Contract W-31-109-ENG-38. 58p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009807.

Ocean thermal energy conversion (OTEC) applications require accurate measurement of temperatures in the 0 to 30°C range. This report documents an experimental examination of commercially available quartz-crystal thermometers and thermistors. Three fixed-point baths were used for temperature measurements: the distilled-water/distilled-ice-water slurry, the triple-point-of-water cell, and the gallium melting-point cell. The temperature of carefully prepared ice-water slurries was verified routinely as 0.001 +- 0.003°C. Quartz-crystal probes proved accurate to about 1 to 2 mK, with drift errors of the same order over a few days. Bead- and disk-type thermistor probes were found to be about equally stable with time in the 0 to 30°C range. The overall probable error of using thermistors was found to be +-4 mK. A solid-block temperature bath suitable for on-site calibrations in OTEC work was used in the temperature-sweeping mode. Various polynomial fits were examined for the purpose of thermistor calibration; fits of order two and higher yielded about equally accurate calculated temperatures.

22567 **(DOE/CE/30719—T3) Ocean Energy Technology assessment.** (Meridian Corp., Falls Church, VA (USA)). Jul 1983. Contract AC01-82CE30719. 201p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85009732.

The Department of Energy Ocean Energy Technology (OET) program is assessed. A summary of OET program activities during the period FY 1980 through FY 1983 documents the most significant findings of DOE-sponsored research and development in each of six program elements: Advanced Power Systems Development, Closed-Cycle Power Systems Development, Alternative Energy Systems Development, Environmental Research, Ocean Engineering, and Engineering Development. The summary is based on extensive review of technical documentation and discussions with DOE and field organization personnel. The result is a concise, comprehensive description of all significant OET activities during the period. Assessment of the current state of ocean technologies is documented through the use of matrices which relate elements of the current ocean technology WBS to a nine-level scale which defines technology status ranging from preliminary feasibility through off-the-shelf availability. These Technical Progress Matrices (TPMs) were developed for each of four ocean system configurations by integrating inputs from seven OET participating field organizations. An evaluation of the critical technical unknowns which would form the basis for future ocean energy public and private research and development activities is presented. This evaluation was accomplished using an accepted technique for group interaction and consensus formation in a meeting of knowledgeable program participants. The results of this meeting are presented in the form of forty minimum essential unknowns (MEUs). An analysis of the correlation of this list of unknowns with DOE policy and selection criteria for acceptable federally-sponsored R & D revealed significant research needs in the areas defined as the primary federal role.

22568 **Method and apparatus for flash evaporation of liquids.** Bharathan, D. (to Dept. of Energy). US Patent 4,474,142. 2 Oct 1984. Filed date 2 Mar 1983. vp.

PAT-APPL-471392.

A vertical tube flash evaporator for introducing a superheated liquid into a flash evaporation chamber includes a vertical inlet tube with a flared diffuser portion at its upper outlet end. A plurality of annular screens are positioned in axially spaced-apart relation to each other around the periphery of the vertical tube and below the diffuser portion thereof. The screens are preferably curved upward in a cup-shaped configuration. These flash evaporators are shown in an ocean thermal energy conversion unit designed for generating electric power from differential temperature gradients in ocean water. The method of use of the flash evaporators of this invention includes flowing liquid upwardly through the vertical tube into the diffuser where initial expansion and boiling occurs quite violently and explosively. Unvaporized liquid sheets and drops collide with each other to enhance surface renewal and evaporation properties, and liquid flowing over the outlet end of the diffuser falls onto the curved screens for further surface renewal and evaporation.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 14090022476, 22518, 22548, 22580, 22793

22569 **(AD-A—149063/0/XAB) Simple model for predicting the flux distribution through the focal plane of a multifaceted-concentrator solar furnace. Interim technical report.** Carlson, D.E.E.; Diver, R.B.; Fletcher, E.A. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). 6 Dec 1984. 12p. NTIS, PC A02/MF A01.

A model of the flux distribution at the focus of a multi-faceted concentrator is presented and compared with the observed performance of a real research furnance.

22570 **(DOE/CE/30737—1) Passive solar manufactured building project. Final report.** (Fleetwood Homes, Inc., Worthington, MN (USA)). Dec 1984. Contract FC02-82CE30737. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85006855.

The initial intent of the reported project was to design a series of passive solar single family detached structures which would incorporate the state of the art in both passive solar engineering and open wall panelization. Primary goals were to develop affordable passive solar assisted housing which would fit into a marketing area covering Minnesota, Wisconsin, Iowa, South Dakota, and North Dakota, utilizing commonly available materials and established building methods. The designs were to be compatible with public taste but flexible. Elevation and floor plans are provided, as well as a cost breakdown, thermogram and air tightness report, and photo documentation. Marketing plans are described, and marketing potential is projected. (LEW)

22571 **(DOE/CS/30334—T2) Community United Methodist Church passive solar classroom addition: comparison of predicted and actual energy use.** Miller, W.H.; Peckham, N. (Missouri Univ., Columbia (USA). Dept. of Nuclear Engineering; Peckham and Wright, Architects, Columbia, MO (USA)). 1984. Contract FC02-80CS30334. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008920.

The Community United Methodist Church of Columbia, Missouri, has recently built a passive solar addition. This building was partially funded by the Department of Energy Passive Solar Commercial Building Demonstration Program (1) and by a grant from the Board of Global Ministries of the United Methodist Church. As part of the design phase, the PASOLE computer code was used to model the thermal characteristics of the building. The building was subsequently completed in September 1981, and one and one-half years of end use energy data has been collected as of March 1983. This paper presents (1) a description of the new building and the computer model used to analyze it, (2) a comparison of predicted and actual energy use, (3) a comparison between the new, solar building and conventional portions of the church complex and (4) summarizes other operational experiences.

22572 **(DOE/R3/02400—T1) [Passive solar heating system]. Final technical report.** Bianco, J.H. (Bianco (James H.), Seaford, DE (USA)). [1985]. Contract FG43-80R302400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009271.

The reason for developing the Biancopanel was to determine the increase in air temperatures while passing over brass finned tubes enclosed in a solar collector. The author wanted to demonstrate that air will circulate by means of natural convection, thus, no fan being required. Passive solar panels were built into the roof between 22-in. center roof rafters. One negative result was the use of plexiglass for the glazing. The author found it became brittle and cracked with the expansion and contraction. Glass glazing was then used. Once the solar panels were installed and sealed into the roof, the author changed the original design concept by adding return and supply ductwork. The supply duct extends down the back wall of the garage to floor level. This procedure gets the heated air to floor level and provides a good air circulation pattern. 3 figures.

22573 **(DOE/R3/06077—T1) Self-insulating passive solar heating system using a heat pipe and phase-change material. Final report, September 30, 1979-September 30, 1981.** Rice, W.J. (Villanova Univ., PA (USA). Dept. of Chemical Engineering). Aug 1981. Contract FG43-79R306077. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85008997.

In this work a combination of heat pipes and thermal-storage-phase-change material was employed to provide an improved, lightweight, window-mounted, solar, heating system having a high efficiency in collecting available solar energy, reduced heat losses to the outdoors, and thermal storage for up to several days. To provide quantitative comparisons of the new system with conventional passive thermal storage walls, the new system and a conventional one were built and installed in adjacent identical windows. Testing was done from February to April 1981. The results obtained showed that this new design provides three significant advantages over conventional passive thermal storage walls in which the packaged thermal storage material is exposed directly to sunlight in a window. The first advantage is that it nearly totally eliminates heat losses from storage. Heat loss from storage is reduced to the loss through the insulation surrounding the storage chamber. The second advantage is permitting thermal storage for several days instead of the few hours possible with the conventional storage walls even with triple glazing or some sort of insertable insulation. In one run thermal energy was stored from Friday to Monday evening in the new system. The third significant advantage is a substantial increase in the efficiency, i.e., the percentage of incident solar energy which can be delivered to the room after sunset. The average efficiency of the heat-pipe unit for fourteen runs was 47.8% while the average efficiency of the conventional unit for the same fourteen runs was only 34.4%.

22574 **(DOE/R3/06078—T1) Marc II Solar Hot Air System. Final report.** Duerr, D. (Duerr (Duane David), Aspers, PA (USA)). 4 Jun 1981. Contract FG43-79R306078. 42p. NTIS, PC A03. File Number DE85009194.

This report describes the design and installation of a prototype to test the concept that a large volume of water will take up-hold-release heat, maintaining temperature fluctuations to a minimum. A solar room was constructed on a south-facing overhang. The insulating curtain consisted of lightweight canvas enclosing polyester batting. When the insulating curtain is raised in the morning, the sun's rays enter through the glazing and strike water-filled barrels maintaining the water at a moderate temperature. At night, the insulating curtain is lowered. The barrels of water are able to heat the air around them and the warm air convects through registers to the living area above. Cool air is returned through cold air returns to be heated in the solar rooms. The design also calls for 29 No. 55 gallon plastic-lined barrels, 4 heat registers and 3 cold air returns at a total cost of $1906.00.

22575 **(DOE/R3/06103—T1) Woodlawn School attached solar greenhouse. Final report.** Lensch, J.E. (Roanoke Independent Sources of Energy, Salem, VA (USA)). 5 Jun 1981. Contract FG43-79R306103. 9p. NTIS, PC A02. File Number DE85008981.

This report describes the design and performance of an attached solar greenhouse which provides between 25 and 45% of Woodlawn School's total heating needs. Excess heat is pumped into a rock storage bin and utilized at a later time. The greenhouse has had additional value to the school in that it provides a living classroom for the students. (DMC)

22576 **(DOE/R3/08072—T1) Trombe wall thermal diode system. Final report.** Brown, M.A. (Jemico, Inc., Columbia, MD (USA)). 26 Mar 1983. Contract FG43-81R308072. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009209.

The development of the Trombe Wall Thermal Diode System is presented. This device was designed to improve the performance of a Trombe wall principally by eliminating convection currents between the heated wall and its glazing cover, and this was to be achieved by using a downwards-facing absorber plate. Two different designs of the Diode were constructed and tested under this contract, and thermal analysis work was done to interpret the results. Unfortunately, the results showed that the concept does not offer any improvement in thermal efficiency over that of a conventional double-glazed Trombe wall. The problem was that convection currents form within the Diode cell, carrying heat from the absorber to the glazing. In the original concept, it was thought that convection currents would naturally form between the hot absorber plate and the cold glazing; but by tilting the plate at a small angle this problem could be eliminated. However, the testing and analysis work has shown that convection currents are formed not by the absorber plate but by the temperature difference between the reflector system and the glazing, even though this difference is very small. The resulting air motion carries some heat away from the absorber plate, so that the overall performance of the Diode is about equal to that of a conventional Trombe wall.

22577 **(ENV-MER—81-308) Study of solar energy utilization for the needs of municipal equipments of the city of Tunis.** Cassou, J.; Potron, A. (Ministere de l'Urbanisme et du Logement, 75 - Paris (France)). Aug 1982. 119p. (In French). NTIS (US Sales Only), PC A06. File Number DE85751001.

This report presents the main ways of utilization of solar energy in Tunisia: hot sanitary water, active solar space heating and bioclimatism. Several municipal installations (municipal showers, kindergartens, sport complexes, townhall...) have been visited and one gives the actions which have been suggested for these ones.

22578 **(LA-UR—84-1680) Establishment of a methodology for predicting lifetimes in active solar systems. Progress report.** Avery, J.G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008629.

Real-time field site and accelerated laboratory data have been generated for five commercially significant metal/fluid combinations found in active solar systems.

22579 **(NBSIR—84-2911) National Bureau of Standards passive solar test facility: instrumentation and site handbook.** Mahajan, B.M. (National Bureau of Standards, Washington, DC (USA). Building Equipment Div.). Aug 1984. 87p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85008632.

The National Bureau of Standards (NBS), under the sponsorship of the US Department of Energy (DOE) has constructed a passive solar test facility. As a part of the DOE's Experimental Systems Research Program, the NBS test facility has been constructed for the purpose of acquiring and distributing to participating researchers class A level performance data for different passive systems. These data are acquired for use in: detailed building energy analysis and model/algorithm validation; and performance characterization of passive subsystems. This handbook provides a complete description of the test building, thermophysical properties of the building material, location of the sensors installed at the test facility, and data acquisition system and procedures.

1410 Solar Collectors And Concentrators

22580 **(DOE/AL/10749—T1) Solar collector studies for solar heating and cooling applications. Final report.** Liers, H.S.; Yenamandra, N.; Brittle, P.N.; Raymond, M.; Edelman, D.G. (InterTechnology/Solar Corp., Warrenton, VA (USA)). 1979. Contract AC04-79AL10749. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85007035.

The objective of this report is to provide a survey of mirror and lens solar concentrator collectors suitable for space heating, cooling, and hot water applications. The scope of the survey includes identification, analysis and comparison for all concentrating collector types for which prototypes and/or market models are or have been built for less than 10X concentration. The survey includes greater than 10X concentration ratios for manufacturers marketing such collectors for space heating and/or cooling applications. To make the survey as complete as possibe, collectors in the conceptual stage are noted and their attributes and disadvantages identified. Major topics discussed include energy collection, tracking, and comparative analysis among different collector types for various locations and heating load types.

22581 **(FRNC-TH—1616) Contribution to the thermo-optical study of the evacuated tube collector.** Meskine, A. (Institut National Polytechnique, 54 - Nancy (France)). Jun 1982. 253p. (In French). NTIS (US Sales Only), PC A12. File Number DE85751009.

This thesis deals with the construction of a theoretical model of evacuated tube solar collectors. This model determines the global conductance of heat losses and correlatively the thermo-optical efficiency of the collector. The optical study shows the transmissivity of the tube collector is better than the transmissivity of the plate collector, and this particularly for a grazing incidence. This involves an utilization of this type of collector on a more important period of the solar day than with a plate collector. This is to be correlated with the low value associated the threshold radiation; this one comes from the combination of vacuum and selectivity. The coupling of these two techniques allows indeed to reduce in a significant manner thermal losses. The experiments carried out, allow to validate the model, particularly in the working temperature range below 90°C; in this case, the conversion efficiency keep high.

22582 **(LA-UR—84-1745) Absorber coatings' degradation.** Moore, S.W. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 11p. (CONF-840676—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008628.

From Renewable energy technologies symposium and international exposition; Anaheim, CA, USA (5 Jun 1984).

This report is intended to document some of the Los Alamos efforts that have been carried out under the Department of Energy (DOE) Active Heating and Cooling Materials Reliability, Maintainability, and Exposure Testing program. Funding for these activities is obtained directly from DOE although they represent a variety of projects and coordination with other agencies. Major limitations to the use of solar energy are the uncertain reliability and lifetimes of solar systems. This program is aimed at determining material operating limitations, durabilities, and failure modes such that materials improvements can be made and lifetimes can be extended. Although many active and passive materials and systems are being studied at Los Alamos, this paper will concentrate on absorber coatings and degradation of these coatings.

22583 **(SERI/TP—255-2670) Silvered polymer reflectors.** Schissel, P.; Neidlinger, H.H.; Czanderna, A.W. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1985. Contract AC02-83CH10093. 12p. (CONF-850252—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008782.

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

One of the principal objectives of the Solar Thermal Research Program is to develop silvered polymer films for constructing durable, low-cost, lightweight concentrating collectors for high temperature solar thermal systems. The mirrors are characterized for their solar-weighted (air mass 1.5) reflectance and exposed to environmental degradation. Photodegradation of polymers has also been studied using Fourier transform infrared spectroscopy supplemented with surface analysis characterization. Results are discussed for extruded films, ultraviolet effects, metallization, and the effects of polymer additives. (LEW)

22584 **Tensioning device for a stretched membrane collector.** Murphy, L.M. (to Dept. of Energy). US Patent 4,483,323. 20 Nov 1984. Filed date 8 Nov 1982. vp.

PAT-APPL-440205.

Disclosed is a solar concentrating collector comprising an elastic membrane member for concentrating sunlight, a frame for holding the membrane member in plane and in tension, and a tensioning means for varying the tension of the membrane member. The tensioning means is disposed at the frame and is adapted to releasably attach the membrane member thereto. The tensioning means is also adapted to uniformly and symmetrically subject the membrane member to stretching forces such that membrane stresses produced therby are distributed uniformly over a thickness of the membrane member and reciprocal twisting moments are substantially prevented from acting about said frame.

22585 **Glass heat pipe evacuated tube solar collector.** McConnell, R.D.; Vansant, J.H. (to Dept. of Energy). US Patent 4,474,170. 2 Oct 1984. Filed date 6 Aug 1981. vp.

PAT-APPL-290282.

A glass heat pipe is adapted for use as a solar energy absorber in an evacuated tube solar collector and for transferring the absorbed solar energy to a working fluid medium or heat sink for storage or practical use. A capillary wick is formed of granular glass particles fused together by heat on the inside surface of the heat pipe with a water glass binder solution to enhance capillary drive distribution of the thermal transfer fluid in the heat pipe throughout the entire inside surface of the evaporator portion of the heat pipe. Selective coatings are used on the heat pipe surface to maximize solar absorption and minimize energy radiation, and the glass wick can alternatively be fabricated with granular particles of black glass or obsidian.

22586 **Solar thermal parabolic dish systems technology and applications.** Leonard, J.A. (Sandia National Laboratories, Albuquerque, New Mexico). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1681-1685(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

This presentation surveys the status and some probable future courses of development of parabolic dish solar collector technology and some of the near-term and long-range applications of the technology. Included are fundamentals of the technology, descriptions of current collectors with particular emphasis on the types developed within the Department of Energy's Solar Thermal Program, descriptions of current systems and applications, key technical issues and tradeoff considerations which will affect the competition between parabolic dish systems and other solar thermal

technologies, and, finally, a discussion of future possibilities for the development of parabolic dish technology.

1420 Heat Storage

REFER ALSO TO CITATION(S) 14200022562, 22563

15 GEOTHERMAL ENERGY

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 15030022591, 23005

1506 Environmental Aspects And Waste Disposal

22587 **(DOE/ET/27196—T18) Investigations and activities of Imperial County geothermal staff: 1982-83. Summary report.** (Imperial, County of, El Centro, CA (USA). Dept. of Public Works). Jan 1984. Contract FC03-79ET27196. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008735.

Research projects initiated, in progress, or completed; County/Industry cooperative efforts; and reports related to geothermal development issued by the County between October 1982 and December 1983 are described.

1508 Geothermal Power Plants

22588 **Effects of vaporizer and evaporative condenser pinch points on geofluid effectiveness and cost of electricity for geothermal binary power plants.** Demuth, O.J. (EG & G Idaho, Inc., Idaho Falls, ID). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1300-1305(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

A brief study was conducted in support of the DOE/DGHT Heat Cycle Research Program to investigate the influences of minimum approach temperature differences occurring in supercritical-heater/vaporizer and evaporative-condenser heat rejection systems on geothermal-electric binary power plant performance and cost of electricity. For the systems investigated optimum pinch points for minimizing cost of electricity were estimated to range from 5 to 7°F (3 to 4°C) for the heater vaporizer. The minimum approach of condensing temperature to wet-bulb temperature for evaporative condensers was estimated to be about 15°F (8°C) in order to achieve the highest plant net geofluid effectiveness, and approximately 30°F (17°C) to attain the minimum cost of electricity.

22589 **Nitinol Heat Engine power plant system installation and cost optimization.** Cady, E.C.; McNichols, J.L. (McDonnell Douglas Astronautics Company, Huntington Beach, CA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1338-1343(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Nitinol Heat Engines (NHE) use a shape memory alloy of nickel and titanium to directly convert the thermal energy in hot water to mechanical power (and, through a generator, to electricity). The authors designed a commercial version of a NHE based on the thermoturbine configuration developed in prototype form under contract to the Department of Energy in 1978-1980. The operation and cost of various forms of NHE have been described previously, but the penalties and costs associated with integrating the complete NHE system into installations supplying the thermal energy have not previously been determined. They found that these costs are most important, as they will often exceed the costs of the NHE proper. However, the total installed costs are quite low and result in very economical power from waste-heat or geothermal hot-water sources.

1509 Geothermal Engineering

22590 **(LBL—19092) CO_2 trends in the depletion of the Larderello vapor-dominated reservoir.** Pruess, K.; Celati, R.; Calore, C.; D'Amore, F. (Lawrence Berkeley Lab., CA (USA); Consiglio Nazionale delle Ricerche, Pisa (Italy). Ist. Internazionale per le Ricerche Geotermiche). Jan 1985. Contract AC03-76SF00098. 8p. (CONF-850107—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008680.

From 10. annual workshop on geothermal reservoir engineering; Stanford, CA, USA (22 Jan 1985).

The present paper is concerned with the origin of CO_2 in the Larderello discharges from a reservoir engineering point of view. Specifically, we consider the question of fluid reserves (water and CO_2) at Larderello, and we carry out numerical simulations to obtain insight into temporal trends of CO_2 released from idealized models of vapor-dominated systems. Important constraints in the modeling arise from observed temperatures and enthalpies at Larderello. Discharge enthalpies are generally close to those of saturated steam near 250°C (2.8 MJ/kg), with some degree of superheat which tends to increase with time. Flow rates of most wells decrease rapidly during the first few years of production and subsequently decline very slowly.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 15200022931

22591 **(DOE/ET/28301—T1) Laboratory investigation of formation damage of an artificial fracture at simulated geothermal conditions. Final report.** Rakop, K.C.; Winzenried, R.W.; Peterson, E. (Terra Tek Research, Salt Lake City, UT (USA)). Mar 1985. Contract AC07-77ET28301. 100p. (TR—85-24). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010301.

Formation damage mechanisms in a fracture-dominated geothermal reservoir were investigated through the use of simulated fractures. The experiments systematically investigated fracture conductivity impairment resulting from exposure to three discrete fluid systems known to be sources of formation damage. The fluids used included: (1) a clear brine containing suspended solids representative of those produced during drilling, (2) two clear brines of incompatible chemical composition which, when intermingled, produce carbonate scaling and precipitation, and (3) a colloidal drilling fluid containing bentonite clay as the colloid. The test program concentrated on fracture conductivity impairment not matrix permeability impairment. The test procedures were designed to simulate the infiltration of drilling fluid into the natural fractures of the geothermal reservoir system. 4 references, 34 figures, 19 tables. (ACR)

17 WIND ENERGY

1703 Regulations

REFER ALSO TO CITATION(S) 17030022598

1706 Wind Energy Engineering

22592 **(DOE/R3/02425—T1) [Construction of a wind turbine]. Final report.** Devine, L.E. (Eastern Lancaster County School District, New Holland, PA (USA)). 22 Mar 1982. Contract FG43-80R302425. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008987.

A wind powered electrical generator was built by industrial arts students working in electricity, woodworking, and metal technology facilities. The blades were originally aluminum frames covered with sailcloth. These were replaced with hand-carved laminated basswood blades. Original plans called for a bullet and downwind propeller, but this was replaced with an upwind propeller and an aft-mounted tailfin. A V-belt and pulley drive transmits power from the turbine and a motorcycle brake stops the machine during

high winds and/or for safe servicing. The original 13 volt, 105 amp alternator was replaced by a 12 volt, 100 amp dc generator. Publicity and dissemination events are listed as well as expenditures. (LEW)

22593 (Juel-Spez—249) **Implementing agreement for cooperation in the development of large scale wind energy conversion systems.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung). Mar 1984. 240p. (CONF-8310379—Summ.). NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513.

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

A summary of the reports and lectures held on the 10th meeting of experts in Palo Alto in October 1983. The meeting was organized within the framework of a contract on cooperation in the development of large wind power plants and was expected to provide information on operational experiences, applicability, and experiences made with large wind power plants. Papers dealing with the experiences made in the USA, Canada, Denmark, Sweden, Greece, and the Federal Republic of Germany are presented to the readers. Each of the 13 presentations was given an individual summary of.

22594 (Juel-Spez—249, pp 1-18) **Utility operating experiences and issues with large-scale wind energy utilization.** Vachon, W.A. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

The large wind power plants with 10 and more MW have a total of appr. 6,000 hours of operation behind them. Some of the appr. 3,000 plants with 20 kW - 1 MW have been running 10,000 to 20,000 hours. The following questions arise from the trial operation up to now: What has been learned from the trial operation until now. Are the test results in agreement with the expectations. And which new developments are likely to come. Using an extensive catalogue of questions, more refined engineering and design questions were obtained. Thus the quality of the power supply, the maintenance costs, safety problems, and questions of reliability are discussed and quantified using the examples of large American wind power plants.

22595 (Juel-Spez—249, pp 19-35) **Operational results for the experimental DOE/NASA MOD-OA, MOD-1 and MOD-2 projects.** Puthoff, R.L. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

The programme of the USA for large wind power plants covers projects of 100 KW up to 7.3 MW. In the introduction, the goals of the programme and the electric interfaces and performance data of the plant types MOD-OA and MOD-1 and MOD-2 are listed. This is followed by a description of the objectives of an investigation which dealt with and quantified the factors influencing the usefulness and the performance of wind power plants. The results show that all of the above plant types are well adapted to the power supply network. Further developments, especially the MOD-5 type, are dealt with at the end.

22596 (Juel-Spez—249, pp 37-78) **Status of wind turbine development in Southern California Edison's service territory.** Yinger, R.J. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

The wind energy programme of Southern California Edison (SCE) contains 3 central points: 1) The estimation of the wind energy potential, 2) Demonstration projects of 4 wind power plants, and 3) Commercial utilization of the wind energy. These 3 main tasks are described with regard to their goals, the present phase of development, and the future steps. SCE is convinced that wind energy is able to make an important contribution to power supply. The reasons are seen in the favourable conditions of utilizing wind energy in the supply region of SCE and also their belief that wind energy is the first alternative energy source which can be utilized commercially.

22597 (Juel-Spez—249, pp 79-85) **Wind system - utility interaction issues.** Balcerak, J.C. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

It happens often that plant failures or disturbances in commercially operated wind power plants cannot be definitely said to be caused by mechanical, structural, or aerodynamic influences. Many times the disturbances are assumed to be due to excessive loads caused by the electricity plants. It is necessary to intensify the research efforts for an improved cooperation of the plant operation, plant constructors, producers of the electro-mechanical parts, and the public utilities.

22598 (Juel-Spez—249, pp 87-104) **Wind power in the Danish electricity supply system.** Moeller, J. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

During the past 5 years, appr. 600 small and 3 large wind energy plants were connected with Denmark's power network. The Danish electric utilities have, especially with a view to their many small plants, published general technical guidelines for network connection, calculation rules for selling and purchasing electric power, and investigations on the power network integration. The article deals briefly with the first two activities and then concentrates on the presentation of the results of the investigations on integrating the plants into the power network. Here, the importance and extent of wind energy production are pointed out, discussing the surplus power production by wind power plants and problems of network control, different current voltage, and probable solutions. Finally, the economic contribution of wind power plants in Denmark is assessed.

22599 (Juel-Spez—249, pp 105-117) **Control of variable speed double-fed winddriven induction generator.** Vollstedt, W. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

The double-fed induction generator of Growian combines the advantages of a fluctuating speed of rotation with the desirable electric properties of a synchronous machine. The generator may be operated avove or below synchronism and with positive or negative power. Besides the stabilization of the machine a decoupled speed-independent control of active or reactive stator power flow is possible when the amplitude and phase currents are properly determined by the control-system.

22600 (Juel-Spez—249, pp 119-128) **Windpark Kythnos.** Heier, S.; Kleinkauf, M. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

Essentially, the electrical equipment for a windpark on the Greek Island of Kythnos being operated in connection with the electric utility grid will be explained. The requirements on control and supervisory of single units as well as the tasks of the coordination unit used for converter-co-operation will be described and a possible technical design will be shown. Measuring results and operating experience of one year are in evidence of the functionality of the whole plant.

22601 (Juel-Spez—249, pp 129-171) **Some current activities in the Canadian wind energy program.** Chappell, M.S. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

The Canadian wind energy research and development programme is based on 3 main objectives: 1) To determine under which circumstances a visible contribution to energy supply can be made by wind energy. 2) To introduce the technology of wind power plants under Canadian conditions, and 3) To encourage and support the Canadian industry to develop and produce wind power plants for the domestic market and the export. The individual components of the Canadian wind energy programme are explained. Field experiments with 50 KW-plants are introduced, giving details on the operational conditions, reliability of the plants, and the power production. Furthermore, combined wind/Diesel power plants and wind power-driven water pumps are introduced.

22602 (Juel-Spez—249, pp 173-181) **Maglarp WTS-3. Review of testing on site and acceptance.** Agrell, M. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

Since its start-up in September 1983, the Maglarp wind power plant in Sweden has been operating in a test run of 850 hours. Some of the main problems encountered during the test phase were pressure losses in the hydraulic accumulators, problems with the sensors, esp. the rotor speed sensor, pecling off of the paint, esp. that of the external coating of the rotor blades, fractures at the welds and struts, and oil losses in several points. These technical problems could be solved efficiently. During its guarantee period, the plant is planned to be compared with the other large wind energy plant in Sweden, the WTS-75 in Naesudden/Gotland, under various test criteria.

22603 (Juel-Spez—249, pp 183-198) **Commissioning of the Swedish 2 MW WTS prototype at Naesudden.** Svensson, G. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

Experiences during the commissioning of the swedish 2 MW WTS prototype at Naesudden on the island of Gotland is summarized. The WTS was formally delivered to the customer, the Swedish Energy Agency, on August 4, 1983. The operation has so far been very successful and the evaluation has just started and will be reported in the middle of 1984.

22604 (Juel-Spez—249, pp 199-204) **Status of wind power at Pacific Gas and Electric Company.** Hillesland, T. Jr.; Steeley, W.J. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

The Pacific Gas and Electric Company considers wind energy as an important element of its power supply. The Company owns and operates a 2.5 MW wind power plant in Solano/California. The article describes the development and measurement programmes of the Company and the site selection process. The construction and performance of the 2.5 MW plant are reported on. The company's future plans concerning wind energy are also discussed in the article.

22605 (Juel-Spez—249, pp 205-229) **Electrical concept of GROWIAN 1 and first experience.** Muehloecker, H. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

Growian 1 is one of the largest wind energy plants in the world. With a power rating of 3 MW, Growian 1 will feed its power into the public supply system. It will be used to investigate the technical and economic preconditions for the utilization of wind energy for power generation in the Federal Republic of Germany. The electrical installations of Growian 1 were planned and carried out by Siemens AG. The individual electrical modules, the safety and control system, and the asynchronous generator are explained by means of various diagrams.

22606 (Juel-Spez—249, pp 231-236) **Status of Bureau of Reclamation's two SVU wind turbines at Medicine Bow, Wyoming.** Hightower, S.J. Mar 1984. NTIS (US Sales Only), PC A11/MF A01. File Number DE85751513. (CONF-8310379—Summ.).

From 10. meeting of experts - utility and operational experiences and issues from major wind installations; Palo Alto, CA, USA (12 Oct 1983).

This paper gives the status of the studies and operational testing being accomplished on the Bureau of Reclamation's two System Verification Unit wind turbines at Medicine Bow, Wyoming. A Hamilton Standard WTS-4 unit rated at 4 MW and a Boeing MOD-2 unit rated at 2.5 MW are currently in operation.

20 ELECTRIC POWER ENGINEERING

22607 (DOE/RA/50276—T1) **Power system dispatcher modeling in the emergency state. Final report.** Entin, E.E.; Pattipati, K.R.; Alexandridis, M.G.; Kleinman, D.L.; Deckert, J.C. (ALPHATECH, Inc., Burlington, MA (USA)). Jul 1984. Contract AC01-80RA50276. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009543.

A normative-descriptive model of a power system dispatcher's cognitive activities encompassing monitoring, short-term planning, and decision making during an emergency situation are described. Also reported are the details and results of a reasonableness assessment study of the dispatcher model. The normative-descriptive model is comprised of: (1) the mental model or internal view that a dispatcher holds of the power system; (2) display monitoring and attention allocation; (3) system cost; and (4) decision making. Human short-term memory capacity, serial processing, chunking, and one-step backtracking are explicitly represented. A set of eight fictional but realistic fault scenarios were developed depicting a loss of one or more transmission lines and/or prime generators. The scenarios were organized into a questionnaire and each scenario was accompanied by eight questions eliciting the respondents rating of various aspects of the dispatcher model's actions. Results show that the reasonableness questionnaire was highly reliable, actions of the dispatcher model were seen as at least moderately reasonable across scenarios, and in a final concensus half of all respondents rated the model's overall actions as at least moderately human operator-like.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 20010022293, 22352, 22354, 22480, 22553, 22623, 22885

22608 (DOE/BP—401) **Selling Power. BPA's direct service industries: changing conditions - changing needs.** (USDOE Bonneville Power Administration, Portland, OR). Feb 1985. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007809.

SP-3-8.

This Backgrounder starts with an explanation of who the District Service Industries are and how they got here - their history in the region. It contains some discussion of the extent and causes of their problems, including the economics of the industry. It is followed by a discussion of the problems their plight causes for BPA and everybody else in the region. Next comes a description of five basic options, with a listing of many of the questions that must be answered relative to each.

22609 (DOE/ET/15020—1634-Vol.5) Primary heater module, Phase II. Volume V. Final report, February 1980-November 1983. Campbell, J. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). Dec 1983. Contract AC21-80ET15020. 180p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85004574.

Research was conducted on components and subassemblies of coal-fired heaters suitable to supply the heat input to closed-cycle gas turbine-based cogeneration systems of 25 to 50 MWe electrical output. Three concepts are researched. The program results indicate that each of the three heater concepts is technically feasible. The fluidized bed concepts are judged most likely to be both technically and commercially feasible. Their continued development is recommended. Vol. 5 consists of Appendix A, which consists of 44 engineering drawings and Appendix B. Appendix B provides a discussion of CCGT-based cogeneration cycle performance. Comparisons are made with OCGT and stream turbine-based cogeneration. The thermodynamic efficiency effects and the effects on the fired heater of variations in cycle operating parameters are discussed. These considerations underlie the conceptual commercial design concepts which, in turn, were used as the basis for identifying the technical issues researched in the AC21-80-ET15020 program. A subsection presents comparisons of steam turbine-based, open-cycle gas turbine (OCGT), and closed-cycle gas turbine (CCGT) based cogeneration systems and discusses the power to heat load ranges and profiles most economically served by each of the three systems. Controllability and operability of each system in conjunction with an AFB combustor also are discussed.

22610 (DOE/RG/10366—T1) Alternative methods for achieving given power system reliability levels. Final report. Yamayee, Z.A.; Boardman, R.W.; Khan, S.U.; Ma, F.S. (Systems Control, Inc., Palo Alto, CA (USA). Energy Systems Div.). Oct 1980. Contract AC01-80RG10366. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85008668.

This work examines the relative cost-effectiveness of competing electrical generating alternatives in contributing to the overall reliability level of a utility system. Three principal issues raised by Section 209 of the 1978 Public Utility Regulatory Policy Act (PURPA) are considered. They are: When there is a need for additional generating capacity, is it cost-effective to: (1) use small unit sizes rather than fewer large units of similar total megawatt capacity, (2) use intermittent and unconventional generating units in place of some conventional units, (3) use generation in decentral rather than central applications.

22611 (EPRI-EA—3890-Vol.1) Economic evaluation of plant-upgrading investments. Volume 1. Summary report. Final report. Farber, M.A. (Temple, Barker and Sloane, Inc., Lexington, MA (USA)). Feb 1985. 25p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $8.50. File Number TI85920513.

Upgrading existing generating facilities may be the most attractive investment alternative for many utilities. The evaluation of upgrading opportunities requires the integration of corporate objectives with economic, financial, and technical studies. When a utility begins examining upgrading opportunities, a top-down, value-based economic analysis can be a powerful approach, because it provides insights into the potential value of such projects as well as guidance in how to proceed. The analysis of individual projects can be simplified and extended because of the unique aspects of upgrading economics. For example, the independence of both displaced power costs and plant utilization from forced outage rate makes it possible to use a disaggregated economic framework to examine the uncertainty of upgrading costs and performance improvement. A complete evaluation of upgrading should also address corporate financial condition and the contribution of upgrading to planning under uncertainty.

22612 (CE-Trans—7787) Starting up a 500 MW unit with pre-oxidation. Torborg, H.H.; Freier, R.K. Translated from *VGB Kraftwerkstechnik ;* **55**: No. 12, 777-782(Dec 1975). 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901123. DE85901123

The Hamburgishe Electricitats-Werke A.G. have been operating their power stations with neutral mineral-free water without alkalisation since 1950. Unit 1 of Moorburg Power Station is the first to be operated solely in this mode after many years of research and investigation in the field of oxygen chemistry had confirmed our policy.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 20020022322, 22323, 22353, 23064, 23104, 23105

22613 (DOE/R3/06122—T1) Alternative methods of power line right-of-way maintenance. Final project report. (Citizens for Environmental Protection, Charleston, WV (USA)). 30 Sep 1981. Contract FG43-79R306122. 179p. NTIS, PC A09. File Number DE85009000.

The objective was to explore and test the feasibility of using local labor resources to partially replace current energy intensive methods in the clearing of vegetation along power line rights-of-way in the rural Appalachian region. A handbook describing this method is included. It addresses the questions of plant identification, time of year for cutting, cutting procedures, tools and safety considerations. Also described is a selective use of herbicides in problem areas where respouting species are dominant. The handbook also contains advice and guidance for landowners on how to contact their power company and reach a mutually beneficial vegetation maintenance contract. (ACR)

22614 (FES—75-79-Vol.1) Supplementary appendix to fiscal year 1976 program. Final environmental statement. Volume I. (Bonneville Power Administration, Portland, OR (USA)). 16 Sep 1975. 587p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE85010086.

Depending upon the final route location chosen, between approximately 146 and 165 miles of 500-kV transmission line between Hot Springs Substation and Bell Substation over parallel and new right-of-way would be required. Between 15 and 70 miles of new access road would also be required. Land use affected would include clearing from 2153 to 2503 acres of timber. Depending upon the route location chosen, between 3 and 4 acres of farmland would be removed from production and between 110 and 165 acres temporarily diarupted. Other impacts would include the removal of wildlife habitat associated with the above-mentioned right-of-way requirements. Disturbance to wildlife during construction would occur. Some erosion and sedimentation would occur. Visual impacts would result from clearing right-of-way through heavily forested areas. Noise and other disturbances to residents will occur, primarily during construction.

22615 (PB—85-144244/XAB) Ponding of effluents from fossil-fuel steam electric power plants. Final report. Farley, K.J.; Harleman, D.R.F.; Morel, F.M.M. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jun 1984. 186p. (MIT/EL—84/007). NTIS, PC A09/MF A01.

Sponsored by American Electric Power Service Corp., NY, Duke Power Co., Charlotte, NC, Public Service Electric and Gas Co., Newark, NJ and Northeast Utilities Service Co., Hartford, CT.

Control of both the suspended solids discharge and the effluent chemistry (pH, trace metal concentrations, etc.) is of primary concern for the operation of ponding facilities. To assess the operational performance of ponds, a mathematical model has been constructed based on hydraulic transport, sedimentation of solids, and chemical reactions. Due to inadequacies in previous descriptions for (chemical) adsorption and sedimentation, the features principally addressed in development of this model have been formulations of new submodels for adsorption (surface precipitation formulation) and sedimentation (including coagulation). Application of the ponding model to fly ash ponds has demonstrated the model's ability in predicting mass removals of solids and in analyzing chemical behavior. From the effort of this research project, improvements in the operations of fly ash ponds have been determined. For solids, increased removal efficiencies can be achieved by decreasing the sluicing rate, increasing the length to width ratio of the pond, and/or proper design of the pond with respect to inflows and outflows. For chemical removal, improvements in the operations of ponds are

difficult to generalize and therefore are treated on a case by case basis.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 20030022613

22616 (BMFT-FB-T—84-245) High power underground cable system with direct water cooling. Blasius, P.; Craatz, P.; Henschel, M.; Harjes, B.; Krieger, W.; Kuenisch, H.J.; Voigt, B. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1984. 201p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE85751106.

Research object is a high power underground cable with direct water-cooling, developed by F and G Carlswerk AG and K and D Lackdrahtfabriken. The objective is to show its suitability for bulk power transmission in densely built-up areas. Additionally, correct working of all necessary apparatus shall be proved under practial operational conditions. Production and shipping of a length of ca. 350 m, laying out the cable in a trench including two bends, a pipe-conduit tract and a tract with thermal insulation. Mounting of six cable joints, installation of the cooling system, measuring of operating parameters due to hydro-dynamics, heat conductivity, mechanics, electrical problems and acoustics, examination of long-term operating behaviour i.e. operation with a current of 5000 A periodically switched on and off over a period of more than 12 months, measuring of electrical and thermal interactions within a trench area with 14 more cable-systems of 0,4 ... 110 kV running in parallel and test of the limiting load, i.e. by doubling the voltage interruption of coolant circulation. The test facility was erected in West-Berlin to test the feasibility of a 110 kV cable with internal conductor cooling. A 300 m three phase system was under test since 1980 having a transmission capacity of 1000 MVA (110 kV). The investigations have shown that transport, laying and installation of the cable and its auxiliaries could be performed without severe problems. These experiences and investigations on the electrical, mechanical, thermal and hydraulic behavior of the internally cooled cable are sucessfully finished.

22617 (DOE/AP/10062—T2) Snettisham line investigation. (Ebasco Services, Inc., Bellevue, WA (USA)). 21 Dec 1984. Contract AC85-84AP10062. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85007852.

The first phase of the study involved the Electro-Magnetic Transient Program (EMTP) studies of the Snettisham line investigation. The EMTP was successfully run with half voltage line energization and with full line energization. The computer runs of the full voltage energization showed a large number of surge arrestor operations with high arrester currents. At half voltage energization, none of the arresters operated and harmonic voltages and currents were considerably less than in the full voltage case. (MOW)

22618 (DOE/RA/50570—1) Lightning protection of distribution systems. Final report. Uman, M.A. (Florida Univ., Gainesville (USA). Dept. of Electrical Engineering). Feb 1985. Contract AC02-81RA50570. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008641.

Analyses are presented of experimental data obtained in the Tampa Bay area during 1978 and 1979 concerning the physical and phenomenological properties of lightning and the interaction of that lightning with the local distribution power systems. Specific results are given regarding: (1) the physical and phenomenology properties of lightning in the Tampa Bay area and its relation to lightning elsewhere; (2) measurement and theory concerning lightning-induced voltages on distribution lines; (3) distribution system operation in the presence of lightning and analytical modeling and prediction of that operation.

22619 (EPRI-EL—3961) Field evaluation of 69-kV outdoor Polysil insulators. Final report. Richenbacher, A.G. (Pennsylvania Power and Light Co., Allentown (USA)). Mar 1985. 35p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $8.50. File Number TI85920532.

After three years of exposure to widely varying climates and environments, Polysil (polymer concrete) 69-kV post-type insulators are still performing satisfactorily. In all test situations, Polysil insulators performed as well as - sometimes even surpassed - their porcelain counterparts. They also demonstrated potential for substantially reducing insulator costs.

22620 (NBSIR—85-3111) Development of power system measurements. Quarterly report, July 1-September 30, 1984. Hebner, R.E. (ed.). (National Bureau of Standards, Washington, DC (USA). Electrosystems Div.). Mar 1985. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009683.

This report documents the progress on four technical investigations sponsored by the Department of Energy and performed by or under a grant from the Electrosystems Division, the National Bureau of Standards. The work described covers the period from July 1, 1984 to September 30, 1984. The report emphasizes the errors associated with measurements of electric and magnetic fields, the properties of corona in compressed SF gas, the measurement of interfacial phenomena in transformer oil, and the measurement of dielectric properties on nanosecond time scales.

22621 (NBSIR—85-3112) Development of power system measurements. Quarterly report, April 1-June 30, 1984. Hebner, R.E. (ed.). (National Bureau of Standards, Washington, DC (USA). Electrosystems Div.). Mar 1985. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009682.

This report documents the progress of three technical investigations sponsored by the Department of Energy and performed by or under a grant from the Electrosystems Division, the National Bureau of Standards. The work described covers the period April 1, 1984 to June 30, 1984. This report emphasizes the errors associated with measurements of dc electric fields, the properties of corona in compressed SF_6 gas, and the measurement of voltage pulses on nanosecond time scales.

22622 (PB—85-143840) Measurements of dc electric fields and ion-related quantities. Final report. McKnight, R.H. (National Bureau of Standards, Washington, DC (USA)). Jul 1984. 28p. Published in Proceedings of Conference on Environmental Ions and Related Biological Effects, Philadelphia, PA, October 30, 1982, p 34-61, July 84.

Measurement techniques developed by atmospheric scientists for characterizing the earth's electrical environment are useful for measuring various electrical parameters near high voltage dc (HVDC) transmission lines. Parameters of primary interest are the electric field, vertical current density, and polar space charge density. Other quantities which have been measured include conductivity, net space charge density and the mobility spectrum of ions making up the space charge. Errors associated with the various measurements are discussed, including those which result from the high electric fields and space charge densities existing near the lines. In addition, these measurement techniques are being used to characterize the operation of biological exposure systems.

21 NUCLEAR POWER PLANTS

22623 (COO—6818-1) Energy Economic Data Base (EEDB) Program: EEDB Program reference book. (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Nov 1982. Contract W-31-109-ENG-38. 392p. NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE85007323.

The computer printouts provide detailed data on costs and quantities of commodities, equipment and manhours for the six nuclear and three coal-fired power plant technical models, included in the Fifth Update.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 21010022411, 22630, 22632, 22636, 22637, 22642, 22643, 22660, 22668, 22669, 22676, 22680, 22686, 22691, 22692, 22694, 22695, 22702, 22703, 22704, 22711, 22712, 22715, 22716

22624 (DOE/ER/10275—1B, pp 66) Pressure vessel embrittlement: the problem and solutions. Main, C.W. (Iowa State Univ., Ames). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

Shortened pressure vessel service lifetime due to embrittlement has become a major problem facing the nuclear industry. To date, twenty-one nuclear power plants have the potential of incurring embrittlement problems before their expected forty year life. Embrittlement is caused by neutron irradiation of material. Irradiation displaces atoms in the microstructure, causing hardening and an increase in the nil-ductile-brittle transition temperature. The rate of embrittlement is influenced by the specific structure and composition of the alloyed steel employed, the neutron environment and the physical environment. Detecting the rate of embrittlement employs Charpy V testing of steel samples placed in the vessel during the initial fuel loading. Solutions of embrittlement, although very costly, are under study. To enable the early-generation facilities to realize their full life, scheduled annealing may become mandatory. To ensure future problems do not occur, methods of alloy reduction and radiation saturation are being studied.

22625 (DOE/ET/34205—T2) Dresden Unit 1: chemical cleaning. Progress report, second quarter. White, J.L. (Commonwealth Research Corp., Chicago, IL (USA)). 14 Jul 1978. Contract AC02-76ET34205. 7p. (COO—4014-10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004668.

The following report defines the activities and status of the Dresden 1 Chemical Cleaning Project during the Second Quarter of 1978. Engineering, testing and construction continued on the facility outside of the sphere and for the materials, systems, and piping within the sphere. These are explained in greater detail in the sections following. During the period, as of June 5, 1988, the total amount of engineering completed of the total amount of approved contract changes, increased to 92%. Additional changes are being submitted by Catalytic Inc., as necessary, and are being reviewed by CECo.

22626 (EGG-RST—6803) Minicomputer-based (Type-3) workstation for the Nuclear Plant Analyzer. Laats, E.T.; Hagen, R.N.; Dobbe, C.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1985. Contract AC07-76ID01570. 43p. NTIS, PC A03/MF A01 - GPO. File Number TI85008437.

A feasibility study was performed by EG & G Idaho to evaluate the possibility of developing a standalone minicomputer-based workstation that would contain and run the Nuclear Plant Analyzer (NPA). System requirements include the ability to execute the RELAP5/MOD2 and TRAC-BD1 computer simulation codes at real wall-clock time, to view the calculated data using the NPA's color graphics software, and to produce an operational system in three to five years. This study addressed three areas: hardware, software, and simulation models. Estimates of improved performance that could be expected from each area were made, and then the estimates were later combined for an overall estimate of projected performance.

22627 (EPRI-NP—3926) In situ application of hardfacing materials in Main Steam Isolation Valves. Final report. Brittain, K.; Dahlke, R.; French, T.; McNeely, W. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Mar 1985. 140p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $16.00. File Number TI85920523.

The Main Steam Isolation Valves (MSIV) in boiling water reactors (BWR) have shown a tendency to fail a local leak rate test (LLRT). Lapping applications were developed to improve seat conditions, but continued lapping or incorrect lapping can result in the need to resurface the seat. The Electric Power Research Institute (EPRI) has initiated research projects (RP-2186-1, -2, and -4) to address the problem of hardfacing in MSIVs. This final report is a compilation of the results of research projects that evaluate the application of hardfacing materials to MSIVs (RP-2186-1) and resurfacing the valve body main seat (RP-2186-2). The report also discusses in-situ application of hardfacing in MSIVs (RP-2186-4).

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 21020022409, 22411, 22414, 22431, 22624, 22626, 22641, 22645, 22647, 22660, 22668, 22669, 22676, 22677, 22678, 22679, 22680, 22682, 22684, 22685, 22686, 22689, 22690, 22693, 22697, 22698, 22701, 22702, 22703, 22704, 22707, 22708, 22710, 22711, 22712, 22715, 22716, 22717, 22923

22628 (DOE/CH/91005—T1) Licensing assessment of extended-burnup fuel. Monthly project status letter, November 1979. Matzie, R.A.; Liu, Y. (Combustion Engineering, Inc., Windsor, CT (USA)). 21 Dec 1979. Contract AT02-76CH91005. 6p. (COO—2426-203). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004664.

The review of existing R and D programs for extended-burnup fuel has been completed. By comparing the data which exists or will be generated by various DOE sponsored programs over the next few years with the licensing requirements for current design fuel as specified in NRC Standard Review Plans, typical licensing submittals, etc., further information needs have been identified. The applicability of analytical models to assess fuel performance, design transients, and LOCA events for extended-burnup fuel are still being studied. Core shroud heating and vessel fluence problems have been examined for the extended-burnup core. The results indicate that the use of extended-burnup fuel has some adverse impact on these concerns. However, they do not appear to be an impediment to the implementation of this fueling concept because of conservatism contained in the data presently used for the standard core designs and because the potnetial limitations on plant operations (e.g. rate of heatup and cooldown) would be insignificant.

22629 (DOE/ET/34212—T3) Qualification of B and W Mark B fuel assembly for high burnup. Quarterly progress report for the period ending September 30, 1978. Snipes, R.G. (Duke Power Co., Charlotte, NC (USA)). Oct 1978. Contract AC02-78ET34212. 5p. (COO—4711-05). NTIS (US Sales Only), PC A02/MF A01; GPO Dep. File Number DE85005401.

The fuel cycle design for Oconee 1 Cycle 5 was completed. Other activities in the extended burnup program are summarized, including poolside examinations. (DLC)

22630 (EGG-RST—6811) Cladding creepdown model for FRAPCON-2. Shah, V.N.; Tolli, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1985. Contract AC07-76ID01570. 105p. NTIS, PC A06/MF A01 - GPO. File Number TI85009723.

This report presents a cladding deformation model developed to analyze cladding creepdown during steady state operation in both a pressurized water reactor (PWR) and a boiling water reactor (BWR). This model accounts for variations in zircaloy cladding heat treatment; cold worked and stress relieved material, typically used in a PWR, and fully recrystallized material, typically used in a BWR. The model calculates cladding creepdown as a function of hoop stress, fast neutron flux, exposure time, and temperature. This report also presents a comparison between cladding creep calculations by this model and corresponding measurements from the KWU/CE program, ORNL HOBBIE experiments, and EPRI/Westinghouse Engineering cooperative project. The comparisons show that the model calculates cladding creep strains well. The analyses of non-fueled rods by FRAPCON-2 show that the cladding creepdown model was correctly incorporated. Also, analysis of a PWR rod test case shows that the FRAPCON-2 code can analyze pellet-cladding mechanical interaction caused by cladding creepdown and fuel swelling.

22631 (EPRI-NP—3847) Microchemistry of corroded intergranular surfaces. Final report. Gibbon, D.L.; Varsanik, R.G. (Calgon Corp., Pittsburgh, PA (USA)). Feb 1985. 38p. Research Reports Center, Box 50490, Palo Alto, CA 94303 $8.50. File Number TI85920521.

Sections of Alloy 600 boiler tubes which had undergone multi-year exposure to typical conditions in a Babcock-and-Wilcox model boiler were received for examination of grain surfaces which had undergone intergranular attack during service. The primary problem was to prepare samples of the desired surface in a way that would not degrade it. This was accomplished by pneumatically inflating the tube sections until they burst; the ductile layer of Alloy 600 expanded plastically, while the exterior IGA layer did not. Subsequent twisting of the metal section caused the outer surface to drop off, exposing the IGA surfaces. Examination of these fresh surfaces was carried out by scanning electron microscopy (SEM), transmission electron microscopy (TEM), wavelength-dispersive x-ray spectroscopy (WDX), energy-dispersive x-ray spectroscopy (EDX), Auger electron spectroscopy (AES), and selected area diffraction (SAD). There appears to be a distinct film of material between the IGA grains on the order of 150 to 200A thick. This film has not been fully characterized, but has been found to be sodium and/or sulfur-rich. Electron diffraction suggests that this layer may consist of a mixed sodium/transition-metal oxide and a nickel sulfide. Confirmation of this hypothesis could best be accomplished by examination of ion-thinned sections of this material in an analytical electron microscope.

22632 (EPRI-NP—3940) Corrosion testing of LOMI decontamination reagents. Final report. Clark, R.L. (SEE CODE- 9512268 Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 78p. NTIS, PC A05/MF A01 - Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50; GPO Dep. File Number DE85009725.

The LOMI (low-oxidation-state metal-ion) chemical decontamination process, by removing radioactive oxides from reactor piping, effectively reduces occupational radiation exposure in PWRs and BWRs. Laboratory tests show that LOMI reagents dissolve oxides without increasing susceptibility to intergranular stress corrosion cracking in the underlying pipe.

22633 (EPRI-NP—3942) Analysis of refueling outages in PWRs of Westinghouse design. Final report. Sarver, S.J.; Candris, A.S.; Skreppen, H. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Div.). Mar 1985. 54p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920559.

The subject report covers nuclear power plant refuelings conducted either by or under the direction of Westinghouse Electric Corporation. Data were gathered from the field concerning refueling delays and their causes. The resulting data base was computerized and analyzed to determine the chief contributors to refueling delays. The main contributors to refueling delays are identified, and their causes are discussed. Recommendations for corrective actions are provided with regard to certain delay-causing incidents. The study covers 96 refuelings at 24 Westinghouse Pressurized Water Reactors (PWRs), both US and foreign, from January 1972 to January 1983. The study focuses on the first seven refueling cycles, because of the limited plant refueling experience available in the data base beyond that point.

22634 (GEND-INF—60-Vol.3) TMI-2 core debris-cesium release/settling test. Volume 3. Akers, D.W.; Johnson, D.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1984. Contract AC07-76ID01570. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008020.

Cesium release, turbidity and airborne potential tests were conducted on 50 grams of TMI-2 core debris materials. The tests were performed on the debris in two conditions: on the as-received core debris specimen, and after crushing the debris to alter the particle size distribution. The crushing was intended to simulate the breakup of TMI-2 core material that may occur during reactor defueling. These tests are intended to assist GPU Nuclear in predicting the effect of defueling on the reactor environment.

22635 (NUREG/CR—3659) Mathematical model for assessing the uncertainties of instrumentation measurements for power and flow of PWR reactors. Hesson, G.M.; Cliff, W.C.; Stevens, D.L. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 44p. (PNL—4973). NTIS (US Sales Only), PC A03/MF A01 - GPO $4.00. File Number TI85008128.

A method of assessing the quantitative uncertainties in the determination of PWR powers and coolant flows caused by measurement uncertainties is provided. The method defines the parameters entering into the calculation, the types and sources of measurement errors which must be considered, together with sources of quantitative data for the uncertainties. A mathematical model is developed which combines the measurement uncertainties in a rigorous statistical manner to give the overall uncertainty in the desired parameter together with a sample calculation.

22636 (PB—85-142735/XAB) Disparities in nuclear power plant performance in the United States and the Federal Republic of Germany. Hansen, K.F.; Winje, D.K. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Dec 1984. 70p. (MIT/EL—84/018). NTIS, PC A04/MF A01.

Sponsored by Electric Power Research Inst., Palo Alto, CA.

This report presents data comparing the performance of light water reactors in the United States and the Federal Republic of Germany (FRG). The comparisons are made for the years 1980-1983 and include 21 Westinghouse Pressurized Water Reactors (PWRs), 22 General Electric Boiling Water Reactors (BWRs) in the US; and 6 Kraftwerk Union (KWU) PWRs and 4 KWJ BWRs in the FRG. Data on capacity losses are presented in a disaggregated form for scheduled outages, forced outages, and regulatory imposed outages. Further, within the scheduled and forced outages, the data is subdivided into losses associated with the nuclear island, the balance of plant, or other causes.

22637 (PB—85-150340/XAB) Windows for innovation: a story of two large-scale technologies. Hazelrigg, G.A.; Roth, E.B. (ECON, Inc., Princeton, NJ (USA)). 1 Dec 1982. 352p. (ECON—82-180-1). NTIS, PC A16/MF A01.

In the report two technologies (communication satellites and light water reactors) are examined to determine the technological, institutional, and economic forces that were at play during their development and implementation. These two technologies embody a wide variety of issues encountered in technology development. Both are large-scale technologies that embody many component technologies; both have profound and widespread social impacts. Communication satellites enabled extensive international communications, and have been instrumental in fostering economic development. Light water reactors have attributes which make them potentially highly beneficial to society; however, they are plagued with potential hazards of considerable magnitude, and their future is being debated in several nations. Both technologies were developed primarily under support from the U.S. government. Although both technologies initially appeared to meet civilian market demands well and promised to enjoy successful periods of implementation, the U.S. nuclear industry may not survive. On the other hand, communication satellites are being implemented at a rate that surpasses the most favorable predictions made in the 1960s.

2103 Power Reactors, Non-breeding, Graphite Moderated

22638 (BNL—36043) Particle fuel bed tests. Horn, F.L.; Powell, J.R.; Savino, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 15p. (CONF-850103—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008290.

From 2. symposium on space nuclear power systems; Albuquerque, NM, USA (14 Jan 1985).

Gas-cooled reactors, using packed beds of small diameter coated fuel particles have been proposed for compact, high-power systems. The particulate fuel used in the tests was 800 microns in diameter, consisting of a thoria kernel coated with 200 microns of pyrocarbon. Typically, the bed of fuel particles was contained in a

ceramic cylinder with porous metallic frits at each end. A dc voltage was applied to the metallic frits and the resulting electric current heated the bed. Heat was removed by passing coolant (helium or hydrogen) through the bed. Candidate frit materials, rhenium, nickel, zirconium carbide, and zirconium oxide were unaffected, while tungsten and tungsten-rhenium lost weight and strength. Zirconium-carbide particles were tested at 2000 K in H_2 for 12 hours with no visible reaction or weight loss.

22639 **(DOE/ET/34034—113) Gas carburization of Inconel 617. Advanced Gas Cooled Reactor Materials Program.** Kimball, O.F. (General Electric Co., Schenectady, NY (USA). Nuclear Systems Technology Operation). Dec 1984. Contract AC03-80ET34034. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008232.

This report describes the progress in the Advanced Gas Cooled Reactor Materials Program on efforts to produce uniformly carburized specimens of Inconel 617 with different carbon levels. This material will be used to determine the effect of carbon content on the mechanical properties and physical properties important for design and use of components in the primary circuit of an advanced HTGR system. The results of gas carburization and high temperature homogenization heat treatments are discussed. Also described are electron microprobe analysis methods for measuring the carbon gradients in the carburized and homogenized material. Recommendations are given for additional work needed to increase the homogeneity of carburized material and for producing material with uniform carbon concentration. Recommendations for improving the accuracy of the EPMA carbon gradient analyses also are included.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 21050022670, 22672

22640 **(DOE/NBM—5009236) Delayed neutron signal characterization in a fast reactor.** Gross, K.C.; Strain, R.V. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009236.

Experimental and analytical techniques have been developed for delayed neutron (DN) signal analysis and characterization that can provide diagnostic information to augment data from cover-gas analyses in the detection and identification of breached elements in an LMFBR. Eleven flow reduction tests have been run in EBR-II to provide base data support for predicting DN signal characteristics during exposed fuel operation. Results from the tests demonstrate the feasibility and practicability of response-analysis techniques for determining the transit time, T/sub tr/, for DN emitters traveling from the core to the detector, and the isotopic holdup time, T/sub h/, of DN precursors in the fuel element. T/sub tr/ has been found to vary with the relative grid location of the DN source, and T/sub h/ is affected by the form of fuel exposed to the coolant as well as the condition of the breach site. These parameters are incorporated into a mathematical formulism that enables one to compute for any exposed-fuel test an equivalent recoil area. This concept provides a basis for comparison of different run-beyond-cladding-breach tests in fast reactors.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 21070022690, 22692, 22694

22641 **(EGG-EA—6652-Rev.1) Conformance to Regulatory Guide 1.97, Callaway Plant, Unit No. 1 (Docket No. 50-483). Revision 1.** Udy, A.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1985. Contract AC07-76ID01570. 20p. NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85008015.

This EG and G Idaho, Inc., report provides a review of the submittals for the Callaway Plant, Unit No. 1, and identifies areas of full conformance to Regulatory Guide 1.97, Revision 2. Any exceptions to these guidelines are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

22642 **(EGG-EA—6734) Conformance to Regulatory Guide 1.97, Brunswick Steam Electric Plant, Unit Nos. 1 and 2 (Docket Nos. 50-325 and 50-324).** Tawfik, M.S. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 19p. NTIS, PC A02/MF A01 - GPO. File Number TI85009883.

This EG and G Idaho, Inc., report reviews the Brunswick Steam Electric Plant, Unit Nos. 1 and 2, submittals for Regulatory Guide 1.97 and identifies areas of nonconformance to the guide. Exceptions to these guidelines are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

22643 **(EGG-EA—6766) Conformance to Regulatory Guide 1.97, Perry Nuclear Power Plant, Unit Nos. 1 and 2 (Docket Nos. 50-440 and 50-441).** Udy, A.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 16p. NTIS, PC A02/MF A01 - GPO. File Number TI85009616.

This EG and G Idaho, Inc., report provides a review of the submittals for Regulatory Guide 1.97, Revision 2, for the Perry Nuclear Power Plant, Unit Nos. 1 and 2. Any exception to the guidelines of Regulatory Guide 1.97 are evaluated.

22644 **(NUREG—0540-Vol.7-No.1) Title List of Documents Made Publicly Available, January 1-31, 1985. Volume 7, No. 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Jan 1985. 661p. NTIS, PC A99/MF A01 - GPO*. File Number TI85901301.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC) during January 1985. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency.

22645 **(NUREG—1104) Technical Specifications, Wolf Creek Generating Station, Unit No. 1 (Docket No. STN 50-482). Appendix A to License No. NPF-32.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 491p. NTIS, PC A21/MF A01 - GPO* $9.50. File Number TI85901223.

The Wolf Creek Generating Station, Unit 1 Technical Specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public.

2108 Economics

22646 **(DOE/ER/10275—1B, pp 46) Discussion of the American nuclear fuel cycle.** Amick, M.; Best, R.; Darveaux, R.; DeCaigny, G.; Dehnbostel, K.; Hansen, P.; . (Iowa State Univ., Ames). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

Twelve Iowa State Nuclear Engineering students have prepared a paper on the fuel cycle with major emphasis on waste management. The current fuel cycle, a once-through method, and the proposed closed back-end approach will be discussed. Each segment of the fuel cycle, mining, processing, core use (reactor), and waste management will be considered with major emphasis on waste management. Waste management is a major issue in nuclear power acceptability consideration. The subject is treated in two parts: present waste management schemes and proposed waste management systems. The first part presents details on type of waste storage handling concepts, the United States Government position on waste management, and away from reactor (AFR) storage of nuclear waste. The second part summarizes the status of proposals dealing with Federal Depositories and fuel reprocessing.

22647 (DOE/ER/10275—1B, pp 49) **Analysis of lumped burnable poison rod usage in PWR core management calculations.** Chang, Y.C. (Purdue Univ., West Lafayette, IN). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The main functions of lumped burnable poison (LBP) rods in PWRs are to suppress local power peaking factors and to hold down the core excess reactivity such that the moderator temperature coefficient can be kept negative. A so-called wet LBP design, announced by Westinghouse in early 1981, yields a lower reactivity penalty at end of cycle than the present design. Thorough studies on wet LBP worths vs accompanied fuel assembly enrichments and number of BP rods are presented. The wet LBP has around 8% less reactivity worth at beginning of cycle, and 12% less reactivity penalty at end of cycle than the dry BP design. Pin peaking power factors within an assembly were also investigated as a function of number of BP rods in the assembly and BP rod location. The perturbation on the local power distribution is about 2% smaller for the wet design than that for the dry design. Suggestions for LBP management and its effects are provided. The calculation model was based on the multigroup two-dimensional collision probability code - CPM.

22 NUCLEAR REACTOR TECHNOLOGY

22648 (DOE/ER/10275—1B) **Proceedings of the 1982 American Nuclear Society Midwest regional student conference.** (American Nuclear Society, La Grange Park, IL). 1982. Contract FG02-82ER10275. 74p. (CONF-820494—Absts.). NTIS, PC A04/MF A01. File Number DE83004081.

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

This conference proceedings contains abstracts for 38 presentations, each of which is indexed separately. (LEW)

2201 Theory And Calculation

22649 (AREAEE—259) **Theories, techniques, and computer codes used in numerical reactor criticality and burnup calculations.** El Osery, I.A. (Atomic Energy Establishment, Inshas (Egypt). Reactors Dept.). 1981. 17p. NTIS, PC A02. File Number DE85900664.

The purpose of this paper is to discuss the theories, techniques and computer codes that are frequently used in numerical reactor criticality and burnup calculations. It is a part of an integrated nuclear reactor calculation scheme conducted by the Reactors Department, Inshas Nuclear Research Center. The crude part in numerical reactor criticality and burnup calculations includes the determination of neutron flux distribution which can be obtained in principle as a solution of Boltzmann transport equation. Numerical methods used for solving transport equations are discussed. Emphasis are made on numerical techniques based on multigroup diffusion theory. These numerical techniques include nodal, modal, and finite difference ones. The most commonly known computer codes utilizing these techniques are reviewed. Some of the main computer codes that have been already developed at the Reactors Department and related to numerical reactor criticality and burnup calculations have been presented.

22650 (DOE/ER/10275—1B, pp 42) **Short history of fission physics research at the University of Illinois.** Swift, G.M. (Univ. of Illinois, Urbana). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The fission physics research efforts can be roughly divided into two broad categories: those dealing with the beta decay of the fission products (or decay heat studies) and those dealing with fission yields. Starting with an experiment which could measure only high energy betas, work in the first category progressed to the point where the decay heating behavior is fairly definitively known. This group of experiments had one major parameter to be measured, so the data were collected using a multichannel analyzer (MCA) and associated coincidence circuitry. The second group of experiments, the fission-yield experiments, on the other hand, were mostly (and are) multi-parameter and thus must use more complicated data acquisition equipment which has been the source of many problems and the object of much effort over the years. Other major efforts in the second category have been in increasing energy (and thus mass) resolution, in measuring the characteristic x-rays of the fission fragments that emit them, and in identifying nuclides by the energy-loss method.

22651 (DOE/ER/10275—1B, pp 60) **Kinetic theory of thermophoresis.** Law, W.S. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The problem of the motion of a sphere under temperature gradient is considered in the framework of the kinetic theory of gases. Numerical results for thermophoresis are compared with available experimental data. The effect of particle-gas thermal conductivity on the thermal force is discussed in some detail.

22652 (DOE/ER/10275—1B, pp 61) **Radiant and convective heat transfer for flow of a transparent gas in a short tube with prescribed sinusoidal wall heat flux.** de Lemos, M.J.S. (Purdue Univ., West Lafayette, IN). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The present analysis accounts for radiant and convective heat transfer for a transparent fluid flowing in a short tube with prescribed wall heat flux. The heat flux distribution used was of sine shape with maximum at the middle of the tube. Such a solution is the approximate one for axial power in a nuclear reactor. The solutions for the tube wall and gas bulk temperatures were obtained by successive substitutions for the wall and gas balance energy equations. The results show a decrease of 30% for the maximum wall temperature using black surface ($e = 1$). In this same case, the increasing in the gas temperature shows a decrease of 58%.

22653 (DOE/ER/10275—1B, pp 65) **Kinetic theory of thermal transpiration and mechanocaloric effect: flow of a polyatomic gas in a cylindrical tube.** Lo, S.S. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The phenomenological coefficients for mass and energy flows due to axial pressure and to temperature gradients on long capillary tubes containing a polyatomic gas at all degrees of rarefaction are reported. The Hansen and Morse polyatomic gas model of the linearized Wang Chang and Uhlenbeck equation was used together with Maxwell's gas-surface interaction boundary conditions. It is found that the thermal transpiration ratio is well predicted by the theory, excepting the case of SO_2; the cross-coefficients are equal, but the profiles are very different in detail, and are strongly dependent on rarefaction; and the cross-coefficients are sensitive to f/sub tr/, the translational Eucken factor but not to f/sub t/, the total Eucken factor.

22654 (DOE/ER/10275—1B, pp 67) **Time dependent advection.** Washington, K.E.; Lee, C.E. (Texas A and Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

Various numerical techniques were investigated and compared for the computer simulation of the pure advection problem $\partial N/\partial t + U\ \partial N/\partial x = 0$ given an initial condition on a periodic lattice. Graphical comparison of the analytical and numerical solutions exhibits the inadequacy of explicit finite difference methods for late time solutions. Investigation of implicit finite difference schemes demonstrated improved accuracy; however, the increased CPU time requirement was large. Equivalent accuracy and considerably

improved computational advantage was exhibited for late time solutions using the ASH exponential operator method (spatial finite differencing), which solves the matrix equation $dX/dt = A X$, $X(t) = \exp(At)X(0)$. Additionally, when the pure advection problem operator spectrum was approximated by Chebyschev polynomials, the ASH method exhibited improved accuracy at even later times. Although a matrix inversion is required in addition to the matrix operations of the ASH solution method, late time solutions are obtained rapidly and accurately for more than 25 periods of a pulse propagating through a periodic system.

22655 (HEDL-SA—3169-FP) Cyclic control oscillations of arbitrary time-dependent reactivity variation. Lan, J.S.; Duncan, D.L.; Omberg, R.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76FF02170. 18p. (CONF-841105—65). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008553.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

Although the control oscillator method is widely being used in measuring reactor parameters and to investigate reactor stability, this useful and practical reactor kinetics problem has not been solved analytically for arbitrary input oscillations. It is the purpose of this paper to show that the analytical solution of power response to time-dependent reactivity oscillations can be derived from the well-known method of singular perturbation for an arbitrary input oscillation. With the differential equations describing a source-free reactor under arbitrary reactivity change at various time steps, it is possible to integrate the precursor balance equation through the application of prompt-jump approximation to the neutron balance equation. The uniqueness of this analytical solution is that it covers an unlimited number of arbitrary-reactivity oscillatory cycles with few simple mathematical functions.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 22020023044

22656 (NUREG/CR—4180) State-of-the-art of solid-state motor controllers. Jaross, R.A.; Mulcahey, T.P.; Koehl, E.R. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 122p. (ANL—84-102). NTIS, PC A06/MF A01 - GPO. File Number TI85008674.

The state-of-the-art of solid-state motor controllers (SSMCs) is assessed in terms of use, probability of Class 1E qualification, failure rate experience, and reliability prediction. Surveys of commercial availability, nuclear and nonnuclear electric utility experience, and architect-engineering use were made relative to the suitability of SSMCs for nuclear service. Reasons for the limited use of SSMCs in nuclear plants are given. Available failure rate data are meager, and are augmented by data on other solid-state power electronic devices that are shown to have subcomponents similar to those found in SSMCs. In addition to large nonnuclear solid-state adjustable-speed motor drives, the reliability of nuclear plant inverter systems and high-voltage solid-state dc transmission line converters is assessed. Class 1E environmental qualification experience with nuclear plant converter/inverters and battery chargers is shown to be directly applicable to SSMCs. No problems are expected in qualifying them. Actual reliability predictions of two typical commercial SSMCs are given, together with predictions of improvements possible with use of high-quality parts and manufacturing procedures.

22657 (CE-Trans—7964) Sensors for core measurements. Brixy, H. Translated from *Atomkernenergie Kerntechnik ;* **41**: No. 3, 154-164(1982). 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85901142. DE85901142

Temperature and neutron flux sensors used in the core region are exposed to environmental conditions which may impair their characteristics. The possibilities and limitations of some frequently used sensors are pointed out and different kinds of sensors are compared.

2204 Control Systems

22658 (DOE/ER/10275—1B, pp 47) Human factors engineering evaluation of the UTR-10 Reactor. Lahti, D.; Nilius, D.; Heithoff, D.; Roche, G.; Sage, S. (Iowa State Univ., Ames). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

This paper is a description of a student design team's review and evaluation of Iowa State University's University Test Reactor (UTR-10). The review was based on how well the control room of the UTR-10 measured up to selected portions of NUREG-0800, chapter 18, Human Factor Engineering/Standard Review Plan Development. The review was conducted by inspecting the reactor and interviewing reactor operators. The control room workspace, instrumentation controls and other equipment were evaluated from a human factors engineering point of view that takes into account both system demands and operator capabilities. Identification, assessment, and suggestion for control room design modifications that correct inadequate or unsuitable items was made.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 22050022687, 22713

22659 (DOE/ER/10275—1B, pp 33) Radioactive effluent monitoring: an overview. Jones, M.L. (Texas A and M Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

22660 (NUREG/CR—4070-Vol.2) Bivalve fouling of nuclear power plant service-water systems. Volume 2. Current status of biofouling surveillance and control techniques. Daling, P.M.; Johnson, K.I. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 66p. (PNL—5300-Vol.2). NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85008532.

This report describes the current status of techniques for detection and control of cooling-water system fouling by bivalve mollusks at nuclear power plants. The effectiveness of these techniques is evaluated on the basis of information gathered from a literature review and in interviews with nuclear power plant personnel. Biofouling detection techniques examined in this report include regular maintenance, in-service inspection, and testing. Generally, these methods have been inadequate for detecting biofouling. Recommendations for improving biofouling detection capabilities are presented. Biofouling prevention (or control) methods that are examined in this report include intake screen systems, thermal treatment, preventive maintenance, chemical treatment alternatives, and antifoulant coatings. Recommendations for improving biofouling control methods at operating nuclear power plants are presented. Additional techniques that could be implemented at future power plants or that require further research are also described.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 22060022658, 22659, 22696

22661 (CONF-801103—69) Software design for LOFT on-line computer systems. Hollenbeck, D.A.; Lindhorst, V.H.; Salomonsen, C.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 8p. NTIS, PC A02/MF A01 - GPO. File Number TI85005391.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The LOFT (Loss-of-Fluid Test) reactor facility is supported with a multiprocessor computer system for data acquisition, on-line data presentation, and other real-time functions. This paper describes the software design of the on-line functions of the LOFT computer system. An expansion of the system to support the LOFT

Augmented Operator Capability Program has been implemented with the incorporation of an Operational Diagnostics and Display System (ODDS) to enhance reactor operator capability for decision making. The integration of the ODDS into the system is discussed with special attention to the software, and data flow through the entire system is traced. Recent developments toward advanced control room applications are addressed.

22662 **(DOE/ER/10275—1B, pp 64) Core modelling code package for MURR.** Pohlman, M. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The University of Missouri Research Reactor (MURR) is the highest powered research reactor on a university campus in the US and is used for a variety of research and service programs. Because of the ever-changing needs of researchers it is inevitable that design changes will be made to meet these needs. These changes, however, can be costly in terms of shutdown time and therefore must be carefully considered as to need and effectiveness. The work presented here will show for core physics calculations by which each design change in the MURR can be modelled before construction and implementation. The package consists of XSDRN (a discrete ordinates spectral averaging code) to process cross sections coupled with Citation (a finite-difference diffusion theory code for core analysis) for depletion and flux profile analysis.

22663 **(HEDL—7430) Structural material irradiations in FFTF.** (Hanford Engineering Development Lab., Richland, WA (USA)). [1985]. Contract AC06-76FF02170. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007778.

Information is presented concerning the Materials Open Test Assembly (MOTA); instrumentation and control system; MOTA neutronic data; pressurized tube specimens; stress-rupture measurements for reactor materials; miniature specimen design; the Interim Examination and Maintenance (IEM) cell at the FFTF; support services; and general information concerning the FFTF.

22664 **(ORNL/TM—9448) Bulk Shielding Facility. Quarterly report, July, August, and September 1984.** Corbett, B.L.; Lance, E.D.; Muggridge, F.E. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008752.

The BSR operated at an average power level of 1737 kW for 0.8% of the time during July, August, and September. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The PCA was not used during the quarter.

22665 **(ORNL/TM—9468) Oak Ridge Research Reactor. Quarterly report, July, August, and September 1984.** Corbett, B.L.; Lance, E.D. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009455.

The ORR operated at an average power level of 29.7 MW for 85.3% of the time during this period. The reactor was shut down on fifteen occasions, nine of which were unscheduled. Reactor downtime needed for refueling and checks was normal. The reactor remained available for operation 88.3% of the time. Special tests completed during the quarter included: (1) transfer of LEU fuel elements CLE-202 and NLE-201 from core positions B-9 and B-2 to core positions C-5 and C-6 for continued operation; and (2) calculation of maximum heat flux in LEU elements CLE-201 and NLE-202 in core positions A-2 and A-8. In-service inspections included inspections of ORR decay tank, primary heat exchanger No. 4, and the 24-in. strainer.

2207 Plutonium And Isotope Production Reactors

22666 **(ORNL/TM—9552) High flux isotope reactor. Quarterly report, October-December 1984.** Dahl, T.L.; Farrar, M.B. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009458.

Routine reactor operation with four end-of-cycle shutdowns, three other scheduled shutdowns, and three unscheduled shutdowns resulted in an on-stream time of 86.8% for the quarter. There were no radiological, environmental, or industrial-related incidents or injuries during the quarter.

22667 **(UNI-TR—10) Primary coolant sampling for activated corrosion product studies at Hanford N Reactor.** Bechtold, D.B. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 31 Jan 1985. Contract AC06-76RL01857. 83p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85008899.

A special system for sampling primary coolant at N Reactor during operation has been constructed and operated from 1977 to 1983. The basic criteria and design for solving the difficult problem of getting representative samples have been presented; this report details how the instrumentation was configured and sampling was done. Equipment and procedures were put together to allow one person to enter a radiation zone, check on 5 monitoring instruments, operate two batch instruments, gather five partitioned samples, record 26 pieces of information, annotate a strip chart and leave the zone in 30 minutes while expending 10 mRem of exposure. Additionally, the reduction of the samples' analysis, digitization of strip chart information and storage of all data on data management systems is maintained. As built, the system provides 0.3 to 1.0 gpm streams of coolant from upstream and downstream of a steam generator. The streams are cooled to 50 to 60°C. The radiation environment averages 20 to 50 mR/hr to the worker. Instruments and special equipment for data gathering at the sampler include pH, conductance, dissolved oxygen, dissolved hydrogen and nitrogen, hot leg and cold leg coolant temperatures, particle sizing, turbidimetry, filtration, and continuous strip chart recording.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 22090023180, 23367

22668 **(BNL-NUREG—28722) Review of light water reactor safety.** Cheng, H.S. (Brookhaven National Lab., Upton, NY (USA)). Dec 1980. Contract AC02-76CH00016. 46p. (CONF-801236—1). NTIS, PC A03/MF A01 - GPO. File Number TI85004729.

From Joint nuclear power and technology conference; Taipei, Taiwan (14 Dec 1980).

A review of the present status of light water reactor (LWR) safety is presented. The review starts with a brief discussion of the outstanding accident scenarios concerning LWRs. Where possible the areas of present technological uncertainties are stressed. To provide a better perspective of reactor safety, it then reviews the probabilistic assessment of the outstanding LWR accidents considered in the Reactor Safety Study (WASH-1400) and discusses the potential impact of the present technological uncertainties on WASH-1400.

22669 **(BNL-NUREG—34655-Rev.) Quench cooling of superheated debris beds in containment during LWR core meltdown accidents.** Ginsberg, T.; Chen, J.C. (Brookhaven National Lab., Upton, NY (USA); Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemical Engineering). 1984. Contract AC02-76CH00016. 10p. (CONF-840914—3-Rev.). NTIS, PC A02/MF A01. File Number TI85007947.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

Light water reactor core meltdown accident sequence studies suggest that superheated debris beds may settle on the concrete floor beneath the reactor vessel. A model for the heat transfer processes during quench of superheated debris beds cooled by an overlying pool of water has been presented in a prior paper. This paper discusses the coolability of decay-heated debris beds from the standpoint of their transient quench characteristics. It is shown that even though a debris bed configuration may be coolable from the point of view of steady-state decay heat removal, the quench behavior from an initially elevated temperature may lead to bed melting prior to quench of the debris.

22670 (CONF-850410—11) **Computational model for debris bed boiling and dryout.** Stein, R.P. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002774.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

CONACS is an LMFBR safety related computer program being developed for DOE by HEDL (WHC). Its purpose is to provide a general code system for analyzing the long term consequences of hypothetical core disruptive accidents. Development of the program is divided into several segments. Contributions related to the formulation of mathematical models for the segment associated with the Reactor Cavity and its Basemat are being developed at ANL. During the course of this development a relatively simple computational model to account for debris bed heat transfer, including boiling and dryout, has been formulated and tested over wide ranges of likely initiating conditions. The formulation intentionally avoids the complications and uncertainties associated with the many phenomenological details which, it is believed, do not have a sufficiently adequate technological base to justify inclusion in a large safety related program such as CONACS. The computational model will be described; its use over wide ranges of initiation conditions illustrated; and arguments will be offered to support its applicability.

22671 (DOE/ER/10275—1B, pp 28) **Improved assessment of effluent releases under accident conditions.** Meyer, C.M. (Texas A and M Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

22672 (DOE/ER/10275—1B, pp 63) **Transient analysis of porous blockages in the CAMEL C-3 and C-4 subassemblies.** Hardy, B. (Univ. of Illinois, Urbana). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

Previously a study of the transient coolability of porous blockages in a liquid metal-fast breeder reactor (LMFBR) flow channel was carried out by Volpenhein. That work analyzed, via a computer code, the coupled thermal and hydraulic system behavior due to a porous plug formed in a subassembly due to a transient overpower accident (TOP). The subassembly with respect to which this analysis was performed had the characteristic hydraulic dimensions of the Fast Flux Test Facility (FFTF) subassembly. The plug was assumed to be cooled by penetration cooling only, neglecting radial and axial conduction in the plug. The current work applies Volpenhein's study to the CAMEL C-3 and C-4 experiments being conducted at Argonne National Laboratory. In addition, radial and axial conduction in the plug have been considered along with peripheral cooling due to bypass flow around the plug.

22673 (EGG-EA—6737) **Sequence Coding and Search System Backfit Quality Assurance Program Plan.** Lovell, C.J.; Stepina, P.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 42p. NTIS, PC A03/MF A01 - GPO. File Number TI85009886.

The Sequence Coding and Search System is a computer-based encoding system for events described in Licensee Event Reports. This data system contains LERs from 1981 to present. Backfit of the data system to include LERs prior to 1981 is required. This report documents the Quality Assurance Program Plan that EG and G Idaho, Inc. will follow while encoding 1980 LERs.

22674 (EGG-EA—6815) **Evaluation of manufacturers of safety-related circuit breakers and motor control centers.** Weber, D.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 61p. NTIS, PC A04/MF A01 - GPO. File Number TI85009724.

This report evaluates vendor-related problems with safety-related circuit breakers and motor control centers in the commercial nuclear industry. Purpose of this task were to determine the vendors' past, present, and future involvement in manufacturing of nuclear Class 1E equipment, develop a prioritized list of vendors based on the amount of nuclear activity, review and analyze problems over the past five years and prepare problem information packages that can be used in follow-up inspections.

22675 (EGG-M—04185) **Estimated post-scram reactor coolant densities from prompt-response self-powered neutron detectors in loss-of-coolant experiments.** Mackley, A.D.; Birchley, J.C. (EG and G Idaho, Inc., Idaho Falls (USA); UKAEA Atomic Energy Establishment, Winfrith). 1985. Contract AC07-76ID01570. 18p. (CONF-850582—6). NTIS, PC A02. File Number DE85009175.

From 31. ISA international instrumentation symposium; San Diego, CA, USA (6 May 1985).

By analysis of the output from self-powered neutron detectors (SPND) in the core of the Loss of Fluid Test (LOFT) Reactor, the authors have estimated local coolant densities in a large break loss of coolant transient. The analysis is based on interaction of gamma radiation as it passes through coolant from the core to the SPNDs. The authors estimated the post-scram temporal behavior in the vicinity of gamma production, converted this to expected SPND behavior and compared the result to observed SPND behavior. The analysis results have provided valuable information in core hydraulic behavior. Though the detectors never were installed and calibrated with the intent to obtain accurate fluid densities, the SPNDs provided spacially and temporally resolved data that is qualitatively excellent and quantitatively good.

22676 (EGG-RST—6791) **Reactor safety computer code development at INEL.** Johnsen, G.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1985. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008007.

This report provides a brief overview of the computer code development programs being conducted at EG and G Idaho, Inc. on behalf of US Nuclear Regulatory Commission and the Department of Energy, Idaho Operations Office. Included are descriptions of the codes being developed, their development status as of the date of this report, and resident code development expertise.

22677 (EGG-SEMI—6809) **Pretest analysis document for Semiscale Test S-FS-1.** Chen, T.H. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1985. Contract AC07-76ID01570. 47p. NTIS, PC A03/MF A01 - GPO. File Number TI85008646.

This report documents the pretest analysis calculation completed with the RELAP5/MOD2/CY21 code for Semiscale Test S-FS-1. The test will simulate the double-ended offset shear of the main steam line at the exit of the broken loop steam generator (downstream of the flow restrictor) and the subsequent plant recovery. The recovery portion of the test consists of a plant stabilization phase and a plant cooldown phase. The recovery procedures involve normal charging/letdown operation, pressurizer heater operation, secondary steam and feed of the unaffected steam generator, and pressurizer auxiliary spray. The test will be terminated after the unaffected steam generator and pressurizer pressures and liquid levels are stable, and the average priamry fluid temperature is stable at about 480 K (405°F) for at least 10 minutes.

22678 (EGG-SEMI—6813) **Experiment operating specification for Semiscale MOD-2C 5% small break loss-of-coolant experiment S-LH-1.** Loomis, G.G. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1985. Contract AC07-76ID01570. 86p. NTIS, PC A05/MF A01 - GPO. File Number TI85009928.

This document presents a combined experiment operating specification (EOS) and appendix detailing information on the S-LH-1 experiment operation, historical background and system configuration. Test S-LH-1 will be a 5%, communicative, cold leg break loss-of-coolant accident (LOCA) simulation performed in the Semiscale MOD-2C facility. Data from this experiment will be examined to identify important phenomena associated with small break loss-of-coolant accidents for benchmarking code calculations. Specifically, S-LH-1 will provide the water reactor safety research

community with a data base involving small break phenomena such as condensation induced liquid filling of the primary steam generator tubes (liquid hold-up [LH]), manometrically induced core liquid level depressions (pump suction liquid seal formation and blowout) and upper head drain characteristics.

22679 **(EGG-SEMI—6830) Pretest analysis document for Semiscale Test S-LH-1.** Shaw, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 41p. NTIS, PC A03/MF A01 - GPO. File Number TI85009884.

Results from various pretest calculations which were performed for Test S-LH-1 are included in this report. Test S-LH-1 has been designed to produce primary liquid holdup in the steam generator U-tubes similar to Tests S-UT-8. The analyses included in this report indicate liquid will be held in the tubes, the core liquid level will be appropriately depressed, and a core heater rod temperature excursion should occur. Several sensitivity studies are also included which identify parameters which could affect the response.

22680 **(EGG-WRR—6784) NRC Division of Accident Evaluation monthly report for December 1984.** Fogarty, F.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1984. Contract AC07-76ID01570. 145p. NTIS, PC A07/MF A01 - GPO. File Number DE85008688.

Research activities and budget information are presented for the Water Reactor Research Test Programs Division; Thermal Fuels Behavior Program; 2D/3D and ROSA-4 programs; and the Reactor Systems Technology Division.

22681 **(EPRI-NP—2956) Effectiveness of thermal ignition devices in lean hydrogen-air-steam mixtures. Final report.** Tamm, H.; McFarlane, R.; Liu, D.D.S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Mar 1985. 135p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920564.

Deliberate ignition of hydrogen at low concentrations in reactor containment systems is one method of controlling hydrogen during degraded core accidents. Since many postulated accident conditions have substantial amounts of steam present, experiments have been performed to determine the hydrogen-air-steam concentration regimes in which ignitors would be effective. In these experiments, both a GM AC 7G thermal glow plug and a Tayco Model 3442 ignitor have been used. These ignitors have been installed in PWR containments with ice condensers and in BWR Mark III containments. This report presents the results of these ignitor effectiveness experiments, and gives the ignition limits and the effect of steam on the ignitor surface temperatures required for ignition.

22682 **(EPRI-NP—3850) Analytical description of PWR pressurizer transients. Final report.** Ahl, J.P. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Mar 1985. 95p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00. File Number TI85920558.

Simulating the complicated physical processes that occur in a PWR pressurizer during a transient presented a considerable challenge to modelers. The computer code developed and validated in this study will help utilities to better understand both the behavior of the pressurizer and the overall performance of a PWR after a loss-of-coolant accident.

22683 **(EPRI-NP—3858) Steam-water flooding in debris beds and its role in dryout. Final report.** Schrock, V.E.; Wang, C.H.; Revankar, S.; Wei, L.H.; Lee, S.Y. (California Univ., Berkeley (USA). Dept. of Nuclear Engineering). Mar 1985. 174p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $17.50. File Number TI85920578.

An experimental investigation has been conducted on flooding of steam and water in isothermal homogeneous beds of particles with an overlying two-phase pool. The beds were spherical particles of 8, 16 and 39 mm diameter and cylinders 16 mm in diameter and length in cylindrical test sections 15 and 30 cm in diameter. Bed depths of 15 cm and 30 cm were employed. Water was injected into the overlying pool at saturation temperature or with 50°C of subcooling. A new flooding correlation was obtained which provides improved prediction of dryout heat flux for internally heated beds of large particles (larger than ~ 1 mm). A theoretical prediction of flooding, based upon relative permeabilities for two-phase flow proposed by Lipinski, was found to agree rather well with the new correlation. A limited study of multi-dimensional effects was included in the experimental program.

22684 **(EPRI-NP—3870) Three-dimensional thermal and fluid mixing analysis using the mass-flow-weighted skew-upwind differencing scheme. Final report.** Hassan, Y.A. (Babcock and Wilcox Co., Lynchburg, VA (USA). Utility Power Generation Div.). Feb 1985. 98p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00. File Number TI85920539.

The upwind finite difference scheme used in the COMMIX-1A code to approximate the convective transport term was shown to contribute more artificial diffusivity to the computed temperature field than the total physical diffusivity that could be inferred from experimental observations of the thermal mixing processes. With aim to reduce such numerical error, a new finite difference scheme called the mass-flow-weighted skew-upwind approach was developed, incorporated in COMMIX-1A, and evaluated by comparison with known analytical solutions and experimental data. This report describes the follow-on activities pursued to demonstrate the applicability of the new finite difference scheme to simulations of pressurized thermal shock events. These activities include benchmarking the code against the Creare one-fifth-scale test 51 and simulating mixing in the full-scale cold leg and downcomer of a Babcock and Wilcox plant using both the upwind and the mass-flow-weighted skew-upwind finite difference scehmes. The new scheme is shown to considerably reduce the amount of artifical diffusivity contributed to the computed temperature field by the convective term approximation.

22685 **(EPRI-NP—3871) Flow visualization during transient cooldown in a model PWR cold leg and downcomer.** Rothe, P.H.; Valenzuela, J.A. (Creare R and D, Inc., Hanover, NH (USA)). Feb 1985. 127p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920533.

This report documents flow visualization studies performed in a 1/5 scale model of the cold leg and downcomer typical of Westinghouse or Combustion Engineering pressurized water reactors which have a horizontal cold leg. Tests were performed with stagnant loop flow and prototypical HPI flow (Froude number F/ sub CL/ = 0.04). In addition to photographs and movies illustrating phenomena and mechanistic descriptions of the behavior, the results include transient velocity profiles in the cold leg and downcomer, HPI buoyant jet entrainment rates and flow split ratios, and transient density profiles in the cold leg. This study will help to clarify the detailed mixing phenomena that are relevant to the thermal-hydraulic aspects of the Pressurized Thermal Shock concern.

22686 **(EPRI-NP—3916) High-amplitude dynamic tests of prototypical nuclear piping systems. Final report.** Howard, G.E.; Walton, W.B.; Johnson, B.A. (Anco Engineers, Inc., Culver City, CA (USA)). Feb 1985. 127p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920510.

A series of high-amplitude dynamic tests have been conducted on two pressurized piping systems representative of nuclear power plant designs. The purpose of the tests was to investigate the seismic response of such piping at stress levels exceeding the limits deemed acceptable by US design standards. The piping - with up to twelve elbows, two reducers, two branch lines, and five supports - exhibited apparent damping of approximately five percent of critical at stress limits associated with the Safe Shutdown Earthquake (SSE) condition. The piping successfully withstood dynamic loading more severe than the equivalent of nine SSEs, including events in which seismic inputs applied through the piping support points had amplitudes up to four times greater than the amplitude required to just exceed the stress limit currently deemed acceptable for the SSE condition.

22687 (EPRI-NP—3948) Postaccident krypton-85 releases and control at nuclear power plants. Final report. Pence, D.T.; Voilleque, P.G. (Science Applications International Corp., San Diego, CA (USA)). Mar 1985. 79p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920568.

Controlled releases of radioactive gases after a nuclear plant accident are below NRC population exposure limits, according to a recent study. Consequently, installing facilities for processing the gases, instead of using standard venting procedures, is unnecessary.

22688 (NUREG—0606-Vol.7-No.1) Unresolved safety issues summary: Aqua book. Volume 7, No. 1. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). 15 Feb 1985. 92p. NTIS, PC A05/MF A01 - GPO*. File Number TI85901173.

This document is designed to provide the management of the Nuclear Regulatory Commission with a quarterly overview of the progress and plans for completion of generic tasks addressing unresolved safety issues reported to Congress pursuant to Section 210 of the Energy Reorganization Act of 1974 as amended. This summary utilizes data collected from the Office of Nuclear Reactor Regulation, Office of Nuclear Regulatory Research, and the national laboratories, and is prepared by the Office of Nuclear Reactor Regulation.

22689 (NUREG—0675-Suppl.30) Safety Evaluation Report related to the operation of Diablo Canyon Nuclear Power Plant, Units 1 and 2 (Docket Nos. 50-275 and 50-323). Supplement No. 30. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1985. 135p. NTIS, PC A07/MF A01 - GPO $5.50. File Number TI85901300.

Supplement 30 to the Safety Evaluation Report for the application by the Pacific Gas and Electric Company (PG and E) to operate the Diablo Canyon Nuclear Power Plant - Unit 2 (Docket No. 50-323) has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. SSER 30 reports on the staff's technical review and evaluation of the design and analysis of Unit 2 piping systems and pipe supports. The staff effort includes an evaluation of PG and E's treatment of issues raised during the Unit 1 design verification, actions resulting from low power License Condition 2.C.(11) in the Unit 1 low power license DPR-76 and the Unit 2 applicability and resolution of certain allegations related to piping and supports.

22690 (NUREG—0787-Suppl.10) Safety Evaluation Report related to the operation of Waterford Steam Electric Station, Unit No. 3 (Docket No. 50-382). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 36p. NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85901248.

Supplement 10 to the Safety Evaluation Report for the application filed by Louisiana Power and Light Company for a license to operate the Waterford Steam Electric Station, Unit 3 (Docket No. 50-382), located in St. Charles Parish, Louisiana, has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The purpose of this supplement is to update the Safety Evaluation Report by providing the staff's evaluation of information submitted by the licensee since the Safety Evaluation Report and its nine previous supplements were issued.

22691 (NUREG—0798-Suppl.5) Safety Evaluation Report related to the operation of Fermi-2 (Docket No. 50-341). Supplement No. 5. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 191p. NTIS, PC A09/MF A01 - GPO* $6.00. File Number TI85901349.

Supplement No. 5 to the Safety Evaluation Report (SER) related to the operation of the Fermi-2 facility, provides the NRC staff's evaluation of additional information submitted by the applicant regarding outstanding review issues identified in Supplement No. 4 to the SER dated September 1984. This supplement contains the staff's conclusion that there are no outstanding issues which must be resolved prior to issuance of a low-power operating license (i.e., less than five percent of full rated power) for the Fermi-2 facility. Supplement No. 5 to the SER also summarizes the conditions which are placed in the Fermi-2 operating license.

22692 (NUREG—0905) Closeout of IE Bulletin 79-12: short-period scrams at boiling-water reactors. Final report. DeBevac, C.J.; Holland, R.A. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Mar 1985. 34p. NTIS, PC A03/MF A01 - GPO* $3.75. File Number TI85901263.

IE Circular 77-07 was issued on April 14, 1977 because of the occurrence of short period scram events at Dresden Unit 2 on December 28, 1976 and at Monticello on February 23, 1977. The circular advised BWR plants to revise their control rod withdrawal sequences and operating procedures to reduce the likelihood of future short period scrams. However, similar events continued to occur. These included events at Oyster Creek on December 14, 1978; at Browns Ferry Unit 1 on January 18, 1979; and at Hatch Unit 1 on January 31, 1979. As a result of these events, IE Bulletin 79-12 was issued on May 31, 1979. This bulletin required a written response from licensees of GE-designed BWRs regarding specific actions listed in the bulletin. All of the licensees responded in a satisfactory manner. No similar events have been reported since IE Bulletin 79-12 was issued.

22693 (NUREG—1031-Suppl.1) Safety Evaluation Report related to the operation of Millstone Nuclear Power Station Unit No. 3 (Docket No. 50-4423). Supplement No. 1. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 96p. NTIS, PC A05/MF A01 - GPO $4.75. File Number TI85901289.

In July 1984 staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report regarding the application of Northeast Nuclear Energy Company (applicant and agent for the owners) for a license to operate Millstone Nuclear Power Station, Unit No. 3 (Docket 50-423). The facility is located in the town of Waterford, New London County, Connecticut, on the north shore of Long Island Sound. This first supplement to NUREG-1031 reports the status of certain items that remained unresolved at the time the Safety Evaluation Report was published.

22694 (NUREG—1048-Suppl.1) Safety Evaluation Report related to the operation of Hope Creek Generating Station (Docket No. 50-354). Supplement No. 1. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 78p. NTIS, PC A05/MF A01 - GPO* $4.50. File Number TI85901243.

Supplement No. 1 to the Safety Evaluation Report on the application filed by Public Service Electric and Gas Company as applicant for itself and Atlantic City Electric Company, as owners, for a license to operate Hope Creek Generating Station has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in Lower Alloways Creek Township in Salem County, New Jersey. This supplement reports the status of certain items that had not been resolved at the time of publication of the Safety Evaluation Report.

22695 (NUREG—1089) Technical Specifications, Fermi-2 (Docket No. 50-341). Appendix A to License No. NPF-33. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 506p. NTIS, PC A22/MF A01 - GPO $10.00. File Number TI85901282.

The Fermi-2 Facility Technical Specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public. This appendix covers the definitions, safety limits and limiting safety system settings, bases, limiting conditions for operation and surveillance requirements, design features, and administrative controls.

22696 (NUREG—1096) Safety Evaluation Report related to the renewal of the operating license for the TRIGA training and research reactor at the University of Utah (Docket No. 50-407). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 74p. NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85901203.

This Safety Evaluation Report for the application filed by the University of Utah (UU) for a renewal of operating license R-126 to continue to operate a training and research reactor facility has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is owned and operated by the University of Utah and is located on its campus in Salt Lake City, Salt Lake County, Utah. The staff concludes that this training reactor facility can continue to be operated by UU without endangering the health and safety of the public.

22697 (NUREG—1117) Technical specifications, Waterford Steam Electric Station, Unit No. 3 (Docket No. 50-382). Appendix A to License No. NPF-38. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 487p. NTIS, PC A21/MF A01 - GPO* $10.00. File Number TI85901172.

The Waterford, Unit 3 Technical Specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public.

22698 (NUREG/CR—3208) TRAC-PD2 developmental assessment. Knight, T.D.; Metzger, V. (comps.). (Los Alamos National Lab., NM (USA)). Jan 1985. Contract W-7405-ENG-36. 368p. (LA—9700-MS). NTIS, PC A16/MF A01 - GPO. File Number TI85008894.

The TRAC-PD2 program provides capability for pressurized water reactors and best-estimate predictions of postulated accidents for many thermal-hydraulic test facilities. The code features a three-dimensional treatment of the pressure vessel and its associated internals; two-phase, nonequilibrium hydrodynamic models; flow-regime-dependent constitutive relations; optional reflood tracking capability for bottom-flood and falling-film quench fronts; and consistent treatment of entire accident sequences including the generation of consistent steady-state conditions. This report describes the final results of the developmental assessment analyses conducted during the later stages of the TRAC-PD2 development. The calculations discussed in this report used the released version of TRAC-PD2 and cover separate-effects blowdown, heat transfer, and downcomer penetration tests together with integral tests from the Loss-of-Fluid Test and Semiscale facilities. Although these calculations are not an exhaustive test of the code, they demonstrate its capabilities, including automatic steady-state initialization and the complete transient from blowdown through refill and reflood. The results show good agreement between the calculated parameters and the data and indicate that the code is applicable to large-break loss-of-coolant accident analyses.

22699 (NUREG/CR—3647) Design and fabrication of a 1/8-scale steel containment model. Reese, R.T.; Horschel, D.S. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 130p. (SAND—84-0048). NTIS, PC A07/MF A01 - GPO. File Number TI85009909.

A 1/8-scale model of a steel containment building was designed and fabricated to support the containment integrity programs being conducted at Sandia. The model will be statically pressurized with nitrogen gas to gain insight into containment building behavior for beyond design-basis pressures. Information on both leakage characteristics and structural response is sought. Data recorded during the testing of the model will be used to qualify analytical methods for predicting containment behavior for severe accidents.

22700 (NUREG/CR—3802) RELAP5 assessment: quantitative key parameters and run time statistics. Kmetyk, L.N.; Buxton, L.D.; Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1984. Contract AC04-76DP00789. 21p. (SAND—84-1013). NTIS, PC A02/MF A01 - GPO. File Number TI85008159.

The advanced best-estimate systems codes currently being developed for the NRC are designed to provide realistic, rather than conservative, predictions of LWR plant behavior during a variety of accidents and transients. The RELAP5 independent code assessment project at Sandia National Laboratories is part of an overall code assessment effort funded by the NRC to arrive at a qualified judgment of the accuracy with which these codes can predict the detailed thermal/hydraulic response of LWRs during accident and off-normal conditions. The heart of the assessment project involves extensive comparison of code results with test data. RELAP5/MOD1 has been assessed at Sandia against a variety of test data from both integral and separate effects test facilities. All these analyses have been documented in detail in individual topical reports and in an overall summary and conclusions report. In this paper, we tabulate the quantitative key parameters for those scenarios which involve leakage of coolant from the primary system to containment, as well as the run time statistics for all the analyses we have performed.

22701 (NUREG/CR—3805-Vol.2) Engineering characterization of ground motion. Task II. Effects of ground motion characteristics on structural response considering localized structural nonlinearities and soil-structure interaction effects. Volume 2. Kennedy, R.P.; Kincaid, R.H.; Short, S.A. (Structural Mechanics Associates, Inc., Newport Beach, CA (USA); Woodward-Clyde Consultants, Walnut Creek, CA (USA)). Mar 1985. 156p. NTIS, PC A08/MF A01 - GPO $5.50. File Number TI85901169.

This report presents the results of part of a two-task study on the engineering characterization of earthquake ground motion for nuclear power plant design. Task I of the study, which is presented in NUREG/CR-3805, Vol. 1, developed a basis for selecting design response spectra taking into account the characteristics of free-field ground motion found to be significant in causing structural damage. Task II incorporates additional considerations of effects of spatial variations of ground motions and soil-structure interaction on foundation motions and structural response. The results of Task II are presented in four parts: (1) effects of ground motion characteristics on structural response of a typical PWR reactor building with localized nonlinearities and soil-structure interaction effects; (2) empirical data on spatial variations of earthquake ground motion; (3) soil-structure interaction effects on structural response; and (4) summary of conclusions and recommendations based on Tasks I and II studies. This report presents the results of the first part of Task II. The results of the other parts will be presented in NUREG/CR-3805, Vols. 3 to 5.

22702 (NUREG/CR—3810-Vol.3) Reactor Safety Research Programs. Quarterly report, July-September 1984. Volume 3. Edler, S.K. (ed.). (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 30p. (PNL—5106-3-Vol.3). NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85008387.

This document summarizes work performed by Pacific Northwest Laboratory from July 1 through September 30, 1984, for the Division of Accident Evaluation and the Division of Engineering Technology, US Nuclear Regulatory Commission. Results from an instrumented fuel assembly irradiation program being performed at Halden, Norway, are reported. Accelerated pellet-cladding interaction modeling is being conducted to predict the probability of fuel rod failure under normal operating conditions. Experimental data and analytical models are being provided to aid in decision making regarding pipe-to-pipe impacts following postulated breaks in high-energy fluid system piping. Fuel assemblies and analytical support are being provided for experimental programs at the Power Burst Facility, Idaho National Engineering Laboratory, Idaho Falls, Idaho. High-temperature materials property tests are being conducted to provide data on severe core damage fuel behavior. Thermal-hydraulic models are being developed to provide better

digital codes to compute the behavior of full-scale reactor systems under postulated accident conditions. Severe fuel damage accident tests are being conducted in the NRU Reactor, Chalk River, Canada.

22703 **(NUREG/CR—3913) HECTR Version 1.0 user's manual.** Camp, A.L.; Wester, M.J.; Dingman, S.E. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 325p. (SAND—84-1522). NTIS, PC A14/MF A01 - GPO. File Number TI85009520.

This report describes the features and use of HECTR Version 1.0. HECTR is a relatively fast-running, lumped-volume containment analysis computer program that is most useful for performing parametric studies. The main purpose of HECTR is to analyze nuclear reactor accidents involving the transport and combustion of hydrogen, but HECTR can also function as an experiment analysis tool and can solve a limited set of other types of containment problems. HECTR Version 1.0 has been particularly tailored to analyze accidents in ice-condenser PWR and Mark III BWR containments. HECTR is designed for flexibility and provides for user control of many important parameters, particularly those related to hydrogen combustion. Built-in correlations and default values of key parameters are also provided.

22704 **(NUREG/CR—3954) HECTR analysis of equipment temperature responses to selected hydrogen burns in an ice condenser containment.** Dandini, V.J.; McCulloch, W.H. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 135p. (SAND—84-1704). NTIS, PC A07/MF A01 - GPO. File Number TI85008508.

The temperature response of three generic surface models in each of three locations in an ice condenser containment building were calculated assuming a hydrogen deflagration event and using the HECTR code. The intent of using the three generic surfaces was to conservatively represent surfaces of various types of safety equipment. Analyses were performed for four accident sequence types with variations. The general observations drawn from these analyses are that (1) higher equipment surface temperatures than calculated for S_2D type arrested sequences were calculated for other sequence types of comparable core melt frequency, and (2) surface temperatures greater than qualification temperatures were calculated to occur for some sequence types.

22705 **(NUREG/CR—3990) Charcoal performance under accident conditions in light-water reactors. Final report.** Deitz, V.R. (Naval Research Lab., Washington, DC (USA)). Mar 1985. 183p. (NRL-Memo—5528). NTIS, PC A09/MF A01 - GPO $6.00. File Number TI85901281.

Nuclear-grade carbons were systematically degraded by exposure to unfiltered outdoor air with decrease in radioactive methyl iodide trapping. Local meteorological conditions of high humidity combined with atmospheric pollutants in the test vicinity contributed jointly to the degradation. When service carbons were exposed to radiation levels of 10^7 to 10^8 rads, the iodine isotope exchange capacity was regenerated. The adsorptive properties were only slightly improved. It was possible to regenerate the iodine isotope-exchange efficiencies by reaction with airborne chemical reducing agents such as hydrazine for carbons removed from nuclear power operations. The depth profile in methyl iodide-131 penetration changed from simple exponentional through new carbons to a non-linear profile for weathered and service aged carbons. The behavior is attributed to the chromatographic distribution of the contaminants that accumulate in the bed. The removal of radioactive iodine depends on a minimum of 3 distinguishable processes: adsorption on the activated carbon, iodine isotope exchange with impregnated iodine-127, and chemical combination with impregnated tertiary amines when present. When a carbon is new, all 3 mechanisms are at peak performance. After the carbon is placed in service, the 3 mechanisms degrade at different rates; the adsorption process degrades faster than the others.

22706 **(NUREG/CR—3998-Vol.2) Light-water-reactor safety materials engineering research programs. Quarterly progress report, April-June 1984. Volume II.** (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 93p. (ANL—84-60-Vol.2). NTIS, PC A05/MF A01 - GPO. File Number TI85009687.

The research and development areas covered are Environmentally Assisted Cracking in Light-Water Reactors, Long-Term Embrittlement of Cast Duplex Stainless Steels in Light-Water-Reactor Systems, and Nondestructive Evaluation and Leak Detection.

22707 **(NUREG/CR—4046) Determining critical flow valve characteristics using extrapolation techniques.** Jarrell, D.B. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1985. Contract AC07-76ID01570. 26p. (EGG—2357). NTIS, PC A02/MF A01 - GPO. File Number TI85009842.

This report presents the methodology and documentation of the calibration of the Loss-of-Fluid Test (LOFT) power-operated relief and safety relief valve (PORV + SRV) for the L9-3 anticipated transient without scram (ATWS) experiment. A multiposition globe valve was calibrated to produce scaled high-pressure flow rates using a low-pressure calibration facility and a simple RELAP5 critical flow model to extrapolate the calibration data to expected operating pressures. It was demonstrated that an accurate high-pressure, multiphase flow calibration can be performed without the necessity of actual high-pressure testing. This technique, when applied to large pressurized water reactor (LPWR) safety and relief valves, represents a potentially large savings in the capacity qualification procedure of full-scale pressure reduction valves.

22708 **(NUREG/CR—4120) Mathematical modeling of ultimate heat sink cooling ponds.** Policastro, A.J.; Wastag, M.; Dunn, W.E.; Leylak, J.; Gavin, P.; Carhart, R.A. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Mar 1985. Contract W-31-109-ENG-38. 274p. (ANL/ES—143). NTIS, PC A12/MF A01 - GPO $7.00. File Number TI85009747.

A general treatment of ultimate heat sink (UHS) cooling pond thermal performance is proposed through the application of a three-dimensional grid model. Validation of the model has been shown through comparisons of predictions with data from a field and laboratory pond. The advantage of the model lies in its ability to determine the detailed character of the flow field whether it be one, two, or three dimensional. Existing models require a priori knowledge of the character and dimensionality of the flow field in such ponds. Application of the model to a prototype UHS pond revealed that the balance of physical mechanisms involved in the thermal hydraulics of these ponds is quite different than for ponds used in normal cooling. The small, heavily-loaded, irregularly-shaped nature of the UHS pond should, in many cases, lead to a vertically mixed pond with only a one-dimensional (longitudinal) variation in pond temperature.

22709 **(NUREG/CR—4172) User's guide for MERGE.** Freeman-Kelly, R.G.; Jung, R.G. (Battelle Columbus Labs., OH (USA)). Mar 1985. 42p. (BMI—2121). NTIS, PC A03/MF A01 - GPO* $4.00. File Number TI85901264.

The MERGE code acts as the interface between the MARCH-2 code, which is used to determine overall accident progression, and the TRAP-MELT code, which is used to evaluate reactor coolant system fission product transport and deposition. MERGE uses MARCH-calculated core exit flows and temperatures to perform a detailed gas-to-structures heat transfer analysis for the control volumes in the flow path through the reactor coolant system and converts these results into a form required as input to TRAP-MELT. MERGE can treat up to nine control volumes, containing up to five structures each. Required inputs include descriptions of the control volumes and their flow connections, as well as initial conditions.

22710 **(PB—85-142693/XAB) TITAN code development for application to a PWR steam-line-break accident, 1983-84. Final report.** Tsai, C.K.; Kazimi, M.S.; Henry, A.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jul 1984. 136p. (MIT/EL—84/014). NTIS, PC A07/MF A01.

Sponsored by Long Island Lighting Co., Mineola, NY, Yankee Atomic Electric Co., Boston, MA and Northeast Utilities Service Co., Hartford, CT.

Modification of the TITAN computer code which enables it to be applied to a PWR steam line break accident has been accomplished. The code now has the capability of simulating an asymmetric inlet coolant temperature transient by employing different temperature transient forcing functions for different core-inlet regions. Up to ten regions of the core can be considered and each region can have at most 50 channels. A total inlet coolant mass flow rate boundary condition option has been added to the code. Flow/coolant temperature transient and control rod transient can be simulated simultaneously by the code as necessary for a steam line break accident simulation. Also, the transient restart capability has been fixed which allows users to change core conditions during a transient calculation for various purposes. All these modifications have been tested by a ten-channel test calculation.

22711 **(PB—85-144251/XAB) TITAN: an advanced three-dimensional coupled neutronic/thermal-hydraulics code for light-water nuclear-reactor-core analysis. Final report.** Griggs, D.P.; Kazimi, M.S.; Henry, A.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jun 1984. 509p. (MIT/EL—84/011). NTIS, PC A22/MF A01.

Sponsored by Long Island Lighting Co., Mineola, NY, Yankee Atomic Electric Co., Boston, MA and Northeast Utilities Service Co., Hartford, CT.

The accurate analysis of nuclear reactor transients frequently requires that neutronics, thermal-hydraulics, and feedback be included. A number of coupled neutronics/thermal-hydraulics codes have been developed for this purpose. Of these, only a few combine three-dimensional neutronics and thermal-hydraulics, and these are either not generally available or too expensive for many applications of interest. Therefore, TITAN, a coupled code combining state-of-the-art three-dimensional neutronics and thermal-hydraulics models, was developed and tested. The three-dimensional nodal neutronics code QUANDRY and the three-dimensional two-fluid thermal-hydraulics code THERMIT are combined into TITAN. Steady-state and transient coupling methodologies based upon a tandem structure were devised and implemented. Additional models for nuclear feedback, equilibrium xenon, and direct moderator heating were added. TITAN was tested using a boiling-water two-channel problem and the coupling methodologies were shown to be effective. Simulated turbine trip transients and several control rod withdrawal transients were analyzed with good results. Sensitivity studies indicated that the time-step size can affect transient results significantly.

22712 **(PNL-SA—12550) Capabilities of probabilistic risk assessment modeled on a micro-computer.** Powers, T.B.; Gallucci, R.H.V. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 10p. (CONF-850206—26). NTIS, PC A02/MF A01 - GPO. File Number TI85007406.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

Responsibility for the Safety Issue Prioritization program is assigned to the Safety Program Evaluation Branch in the Office of Nuclear Reactor Regulation. The program ranks the importance of reactor safety issues using quantitative measures of benefits and costs associated with the resolution of an issue along with qualitative factors. Because of the large number of issues to be analyzed in the ranking process, a procedure was developed that would permit each issue to be analyzed with a level-of-effort amounting to two man-weeks of labor. Existing risk, cost, and dose information are used in the analysis whenever possible. Existing probabilistic risk assessments (PRAs) have been used in evaluating the change in public risk that would result from resolution of an issue. This paper briefly describes the issue analysis procedure and how the micro-computer programs are used in following the procedure. Next is a list of the PRAs that have been modeled and a discussion of how the micro-computer programs model the PRAs. Finally the advantages and the potential applications of these programs are described.

22713 **(PNL-SA—12584) Exercise Evaluation and Simulation Facility (EESF).** Meitzler, W.D.; Jaske, R.T. (Pacific Northwest Labs., Richland, WA (USA); Federal Emergency Management Agency, Washington, DC (USA)). Jan 1985. Contract AC06-76RL01830. 6p. (CONF-850108—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007501.

From SCS multiconference on modeling and simulation; San Diego, CA, USA (24 Jan 1985).

The Integrated Emergency Management and Information System (IEMIS) is a minicomputer based system that serves initially as a tool to assist FEMA in the evaluation of emergency plans and preparedness for natural and technological hazards. As an IEMIS subsystem, the Exercise Evaluation and Simulation Facility (EESF) provides capabilities specific to emergency exercises and plan development for application near commercial nuclear power facilities. EESF integrates the following resources: a meteorology model, evacuation model, dose model, maps, and exercise information into a single operational package. The user may access thee various resources, and on completion display the results on a color graphic display or hardcopy unit. Key to the capability provided by EESF are the ease of use and quick comprehension of results presented via the graphic displays.

22714 **(SAND—85-0284C) Instrumentation, data acquisition, and control in a 1/8-scale containment model.** Koenig, L.N.; Lambert, L.D. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850582—3). NTIS, PC A02/MF A01. File Number TI85006899.

From 31. ISA international instrumentation symposium; San Diego, CA, USA (6 May 1985).

As part of a US Nuclear Regulatory Commission-sponsored program on reactor containment integrity, Sandia National Laboratories tested a 1/8-scale model of a steel containment building. The model was pressurized with nitrogen gas to rupture. Because of the hazards associated with high-pressure testing with a gas, the test was controlled and data gathered remotely with a data-acquisition-and-control system. The data-acquisition-and-control system and the special instrumentation used to record the large deformations experienced by the model are described.

22715 **(UCRL—91251) Seismic analysis response factors and design margins of piping systems.** Shieh, L.C.; Tsai, N.C.; Yang, M.S.; Wong, W.L. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 8p. (CONF-850809—45). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85008296.

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Median response and its variability and correlation are the elements required in the calculation of component failure probability. Conservatism or non-conservatism of the seismic response of piping system generated by the plant design procedures must be removed. The Lawrence Livermore National Laboratory under contract to the US Nuclear Regulatory Commission developed an overall seismic risk assessment methodology which was applied to the seismic probabilistic risk assessment at the Zion Nuclear Power Plant. The results of the study are presented.

22716 **(RISLEY-Trans—4522) Human error: a fundamental problem in nuclear power stations.** Smidt, D. Translated from *VGB Kraftwerkstechnik ;* **61**: No. 6, 471-477(Jun 1981). 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901144. DE85901144

The role of man in the nuclear power station is defined in order to examine the structure of his tactical and strategic error in more detail. Following a discussion about tactical errors and ways to avoid them comes a report on the present state of plant technology and possible improvements. Then there is an investigation of the strategic errors.

22717 (CE-Trans—8062) Operation of pumps in two-phase water-steam flow. Grison, P.; Lauro, J.F. Translated from *Entropie ;* 14: No. 83, 26-32(1978). 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901236. DE85901236

The determination of the two-phase flow (critical or otherwise) through a pump is an essential element in a complete description of a loss of coolant accident in a PWR reactor. This article describes the theoretical and experimental research carried out on this subject in France. First of all the model of the pump is described, and its behaviour is examined in various possible cases, particularly in the case of critical flow. The analysis of the pump behaviour is then used to define the experimental test conditions. Two test loops have been built: EVA and EPOPEE. The experimental results are then compared with the theoretical predictions.

25 ENERGY STORAGE

2506 Thermal

REFER ALSO TO CITATION(S) 2506022562, 22563

22718 High temperature composite thermal storage systems. Petri, R.J.; Olszewski, M.; Ong, E.T. (Inst. of Gas Technology). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 2: 1097-1102(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

An advanced, thermal energy storage subsystem is being developed by IGT which employs composite phase change material (PCM)/sensible heat material media. This medium/subsystem is amenable to high temperature thermal storage applications such as industrial reject/process heat recovery and utilization, off-peak utility and solar thermal power system applications. The concept allows for direct contact heat exchange between the latent/ sensible storage media and compatible working fluids. A number of potentially significant TES system performance and cost advantages are thereby offered over conventional molten-salt latent-heat based storage subsystems.

2509 Batteries

22719 (AD-A—148673/7/XAB) Physical properties of the nickel composite sintered plaque. Interim technical report, 1981-1982. Ferrando, W.A.; Lee, W.W.; Lee, A.L.; Sutula, R.A. (Naval Surface Weapons Center, Silver Spring, MD (USA)). Dec 1982. 31p. (NSWC-TR—82-416). NTIS, PC A03/MF A01.

The nickel composite plaque is a new concept in sintered substrates for application in alkaline energy storage systems. The plaque is fabricated from nickel coated graphite fibers which, upon sintering in reducing atmosphere, produces a strong lightweight structure of open porosity suitable for electrode use. The four test areas of this report include: tensile strength, porosity, electrical resistivity and SEM micrography of the plaque structure. Porosities of 55 to over 90 percent void volume are achievable with the composite plaques, while maintaining structural integrity. Porosimetry measurements indicate approximately a 4X greater than mean pore size and 1.5X broader pore size distribution than commercial powder sinter. Tensile strengths were measured as a function of nickel coating thicknesses.

22720 (AD-A—148982/2/XAB) Two-photoelectrode solid-state photoelectrochemical cell. Sammells, A.F.; Schmidt, S.K. (Eltron Research, Inc., Naperville, IL (USA)). 14 Sep 1984. 13p. NTIS, PC A02/MF A01.

The solid-state photoelectrochemical cell p-InP/ C44H28N4Fe(+3) Porphine, Nafion 117/Nafion 117/ (bpy)3Ru(2+), Nafion 117/n-Cds was prepared and given photopotentials in excess of 1100 mV and appears to be a novel approach for not only specialized storage devices but also in specific detector applications.

22721 (AD-A—149444/2/XAB) Polymer electrolytes: an investigation of some poly (n-propylaziridine)/lithium salt compositions. Technical report. Baldwin, K.R.; Golder, A.J.; Knight, J. (Royal Aircraft Establishment, Farnborough (UK)). Apr 1984. 26p. (RAE-TR—84036). NTIS, PC A03/ MF A01.

Some poly(N-propylaziridine)/lithium salt compositions have been synthesized and their electrical conductivities have been measured in order to assess their suitability as electrolytes in safe, leak-proof, high energy-density lithium batteries operating at ambient temperature. The effects on conductivity of temperature, and the nature and concentration of the salt have also been studied. The presence of the salts markedly improved the conductivity of the compositions over that of the undoped polymer but they were insufficiently conducting to be considered as battery electrolytes, due possibly to ion-pairing. Their creep resistance was also low. It was concluded that less fluid compositions containing higher molecular weight polymers better able to promote ion separation would be more suitable.

22722 (FRNC-TH—1618) Electrochemical oxidation of lead in H_2O-H_2SO_4 mixtures: application to the negative electrode discharge in load storage batteries. Danel, V. (Ecole Nationale Superieure de Chimie, 75 - Paris (France)). Jul 1982. 120p. (In French). NTIS (US Sales Only), PC A06. File Number DE85751012.

The effect of sulfuric acid concentration on the formation of $PbSO_4$ is studied. The species Pb(II) in H_2SO_4 medium is examined to obtain data on lead dissolution. General aspects of oxidation of lead to lead sulfate are considered and also the importance of dissolution in the performance of the batteries, studied by means of a ring-disc electrode. 68 references.

22723 (LBL—18716) Electrochemical and morphological study of the effect of temperature on the restructuring and loss of capacity of alkaline battery electrodes. Final report. Macdonald, D.D.; Pound, B.G.; Lenhart, S.J. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85006869.

The degradation processes occurring within porous nickel battery electrodes were investigated during charge/discharge cycling at temperatures in the range 0 to 100°C. The ac impedance of two types of porous nickel electrodes (sintered electrodes and rolled and bonded electrodes) in a 8 m KOH solution was measured, and the data were analyzed in terms of a transmission line model (TLM). In addition, cyclic voltammetry was used to study the characteristics of the oxygen evolution reaction on nickel electrodes during charging. Impedance data of planar, non-porous electrodes were obtained over a range of potentials and temperatures in order to provide an equivalent circuit to model the pore-wall and backing-plate interfacial impedance components in the TLM. Parameters in the TLM were curve-fitted to experimental impedance data obtained for porous electrodes at different stages of cycling. Changes in these parameters with cycling time for rolled and bonded electrodes were consistent with experimental observations, and could be attributed to various degradation processes. The principal changes found to occur with increasing cycle number were that the average pore effective length decreases and the average solid-phase resistivity increases. The impedance data for sintered electrodes do not change during galvanostatic cycling and failures occur abruptly after a relatively large number of cycles. Consequently, the TLM provides little insight into cycle-dependent degradation phenomena on sintered electrodes.

22724 (N—85-10444) Advanced nickel-hydrogen cell configuration study. Final report. Adler, E.; Perez, F. (Hughes Aircraft Co., El Segundo, CA (USA)). Oct 1984. 74p. (NASA-CR—174775). NTIS, PC A04/MF A01.

Three nickel hydrogen battery designs, individual pressure vessel (IPV), common pressure vessel (CPV), and a bipolar battery module were studied. Weight, system complexity and cost were compared for a satellite operating in a 6 hour, 5600 nautical mile orbit. The required energy storage is 52 kWh. A 25% improvement in specific energy is observed by employing a bipolar battery versus

a battery comprised of hundreds of IPV's. Further weight benefits are realized by the development of light weight technologies in the bipolar design.

22725 **(SAND—84-1510) Additional experiments relative to the shelf life of Li(Si)/FeS_2 thermal batteries.** Searcy, J.Q.; Armijo, J.R. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008482.

Work described in this report is part of a continuing effort to develop a new thermal battery technology based on the Li(Si)/FeS_2 electrochemical couple. The results reported relate to the long shelf-life requirement for thermal batteries designed by Sandia, and include topics relevant to leakage through the hermetic seal and accelerated aging experiments with materials new to the technology. Conclusions relevant to leakage through the hermetic seal are that the maximum leak rate must not exceed 1.8×10^{-7} w, where w is the grams of Li(Si) contained by a battery, and that a bomb-type leak test can be designed that is adequate for most Li(Si)/FeS_2 batteries. Conclusions relevant to long-term compatibility of new materials include the following: nickel is not compatible with the iron disulfide in the cathode; the $CaSi_2$ additive used to suppress the initial voltage transient does not react or degrade during accelerated aging experiments, but the use of that material can lead to an increase in the variability of the activated lives, especially for long-life batteries; Grafoil current collectors used with the cathode do not degrade in accelerated aging experiments.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 29010022742, 22743

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 29020022364, 22373, 22733, 22745, 22751

22726 **(IIES-pre—83-9) Energy policy in the consumer interest.** Struempel, B. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751511.

From 1. international conference on consumer behaviour and energy policy; Noordwijkerhout (Netherlands) (1982).

How does the energy problem faced by Western societies affect the consumer 10 years after the oil embargo. The steep increase in the energy bill has led to severe strains on the social fabric in terms of maldistribution, social conflict, and probably also of unemployment. This is so because by and large the hard, supply-oriented path of merely substituting domestic energies and nuclear power for imported oil was chosen, and the task of conservation was left to the price mechanism. The fact that up to now the soft path has been largely neglected, is traced to three factors: to the inertia of institutions, first the energy industry, second the political system at large, and third to an "ideological lag" in popular beliefs abouth the economy. The implications for policy are drawn. Rather than only an individual economic choice via information and motivation, consumer research and action in the energy field ought to focus on collective choice as well.

22727 **(PB—85-146249/XAB) Western Europe's economic relations in a North/South perspective; a study of the trade links between the EC and the Third World and EC's energy and raw material dependence.** Bergstrand, B.G. (Foersvarets Forskningsanstalt, Sundbyberg (Sweden)). Apr 1984. 213p. (In Swedish). (FOA-C—10246-M5). NTIS, PC E10/MF E01.

The purpose of the study is to analyze Western Europe's/EC's economic relations with the Third World and particularly the question whether the EC could be said to be dependent on the developing countries for its supply of energy and raw materials in a way that might also have implications for European security policy. In an introductory chapter, the background to and the approach of the study is presented. In the second chapter, the trade agreements and other treaties that regulate commerce between the EC and the Third World are assessed. Following this discussion, the actual trade flows are analyzed. In the fourth chapter, the question of raw material dependency is considered in general terms, and partly so from the perspective of developing countries. In the fifth chapter, the EC demand for energy and raw materials is discussed in depth. In the concluding chapter, the various viewpoints previously expressed are summarized.

22728 **(PB—85-150126/XAB) Non-Tariff Barriers to high-technology trade. Final report.** Cohen, R.; Ferguson, R.; Oppenheimer, M. (Futures Group, Glastonbury, CT (USA)). Oct 1984. 162p. (R—668-46-31). NTIS, PC A08/MF A01.

Non-Tariff Barriers (NTBs) are introduced and background on the various types of NTBs is provided. NTBs have gained increasing prominence as commercial and diplomatic issues and have induced countries to adopt non-tariff measures to protect those industries deprived of tariff protection. In addition, NTBs have proved to be important tools for governments to use in promoting growth and international competition for specific, targeted sectors. NTBs are less constrained by international law than are tariffs and are more subtle in their effect. NTBs have greater impacts on small firms than on large ones because of the lack of international investment on the part of most small firms. The U.S. government needs more and better information about NTBs and about their impacts on individual firms and industries and on the U.S. economy. The government agencies and offices that deal with NTBs facing high technology firms must increase their expertise, and the government must establish an up-to-date data base on NTBs. Special attention should also be paid to the use of incompatible standards and protocols by foreign governments in industries such as telecommunications.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 29030022364, 23067, 23072, 23171

22729 **(AD-A—148067/2/XAB) Installation restoration program. Phase I. Records search for the 5073rd Air Base Group, Shemya AFB, Alaska. Final report.** Greiling, R.W.; Abbott, D.W.; O'Flaherty, P.M.; Steiner, G.J. (JRB Associates, Inc., Bellevue, WA (USA)). 21 Sep 1984. 190p. NTIS, PC A09/MF A01.

A search of USAF, state, and federal agency records and interviews with past and present base personnel and agency representatives was conducted to identify past hazardous-waste generation and disposal practices at Shemya AFB, Alaska. The AFB occupies the entirety of Shemya Island, located at the western end of the Aleutian Islands. Twenty-eight sites were identified and inspected as potential hazardous-waste sites. Numerical ranking of 20 sites was warranted based upon potential for contaminant release and environmental degradation. Petroleum storage, waste disposal, and spills account for the most-frequent and severe problems. Follow-on recommendations include site cleanup and closure, confirmation studies in the vicinity of past spill sites, and enhanced protection of the shallow groundwater aquifer.

22730 **(CONF-8410171—5) Methods in risk management - a working paper.** Uppuluri, V.R.R. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02. File Number DE85008360.

From US/Japan workshop on tritium radiobiology and health physics; Tokyo, Japan (29 Oct 1984).

The methods in Risk Analysis to determine the health and environmental effects of hazards to individuals and society are evolving in this rapidly developing field. In this paper, we briefly discuss the current distinctions between Risk Assessment and Risk Management, and discuss some methodological issues. We conclude this paper with a method useful for prioritization in connection with the environmental, health, and safety deficiencies at a number of sites. 9 references.

22731 **(PB—85-138642/XAB) Fail-safe devices for the prevention of hazardous-material spills. Final report, December 1979-1981.** Heard, D.B. (Factory Mutual Research Corp., Norwood, MA (USA)). Dec 1984. 84p. NTIS, PC A05/MF A01.

Hazardous material spills have often been caused by over filling containers. Many spills could be prevented by using automatic container-filling procedures to determine when maximum capacity is reached. This project conducted an assessment of current technology, including laboratory testing of devices and performance monitoring of on-site automatic level controllers. Three industrial plants cooperated in the field testing phase, each having a different problem with a different material. The types of level control devices chosen were ultrasonic, vibrating tines, and a magnetic-coupled float unit. Two of the units were activated by electricity, and the third was pneumatic. One unit controlled dry powder; the second, a viscous liquid; and the third, an aqueous liquid. Each location required an explosion-proof system. All were subjected to the extremes of weather, and all were installed without significant revisions to existing containers. The on-site experience at host plants demonstrated that fail-safe level controllers can work well for an extended period under severe weather conditions. The proper controller configuration must be chosen to be compatible with the environment and with the material being controlled. Controllers should incorporate requisite safeguards to assure safety and be resistant to corrosion, fouling and weather.

2904 Natural Resources

REFER ALSO TO CITATION(S) 29040022727

22732 **(N—85-11435) Remote sensing applications program.** (Mississippi State Univ., Mississippi State (USA)). Nov 1984. 36p. (E—85-10022; NASA-CR—174045). NTIS, PC A03/MF A01.

The activities of the Mississippi Remote Sensing Center are described in addition to technology transfer and information dissemination, remote sensing topics such as timber identification, water quality, flood prevention, land use, erosion control, animal habitats, and environmental impact studies are also discussed.

22733 **(PB—85-139228/XAB) Role of mining in the South African economy.** Lombard, J.A.; Stadler, J.J. (Pretoria Univ. (South Africa). Bureau for Economic Policy and Analysis). 1984. 300p. NTIS, PC E12/MF E01.

The object of the analyses presented in the various chapters of this study is to describe the economic significance of the mining industry in the economy of South Africa in terms of the available official statistical data. For purposes of the analyses, the mining industry was disaggregated into gold, coal and other mining. Although data on mining production is indeed abundant, problems were sometimes encountered with regard to data on certain other important facets of the economic impact of mining. The macro economic dimensions of mining on which this study became focussed are the production function, the investment function, the employment function, the determination of prices and costs, the distribution of the operation surplus, savings-investment equation and the balance of current payments with the rest of the world.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 29050022728

22734 **(PNL—5500-Pt.2) Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 2. Ecological sciences.** Novich, C.M. (ed.). (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010099.

Research progress is reported in the following areas: (1) the terrestrial ecology of semi-arid sites; (2) marine sciences; (3) radionuclide fate and effects; (4) waste mobilization, fate and effects; and (5) theoretical research on environmental sampling. (ACR)

2906 Nuclear Energy

22735 **(AD-A—149469/9/XAB) Soviet theater nuclear forces issues. Final report, 1 September 1978-30 November 1979.** Friedman, N.; Gray, C.S. (Hudson Inst., Inc., Croton-on-Hudson, NY (USA)). 1 Dec 1979. 188p. (HI—3113-RR). NTIS, PC A09/MF A01.

This study examines the Soviet approach to transition from conventional to theater nuclear war in the context of Soviet political and military style. The factors governing the Soviet approach to nuclear transition are examined in Part 1 of the study. Part 2 explores a wide array of incentives and disincentives for Soviet nuclear transition and suggests ways in which NATO actions can affect the balance of incentives and disincentives facing the Soviet planner. Part 3 integrates and summarizes the conclusions of Parts 1 and 2, and suggests measures for NATO action.

22736 **(AD-A—149481/4/XAB) Strategic employment of the Soviet Navy in a nuclear war. Doctoral thesis.** Tritten, J.J. (University of Southern California, Los Angeles (USA)). Dec 1984. 571p. NTIS, PC A24/MF A01.

This study is primarily concerned with what appears to be the primary role of the Soviet Navy: preparation for fighting of a nuclear war involving the USSR and the U.S. in which the homeland of each of these nation's is threatened with or subjected to destruction by long-range strategic nuclear systems (as strategic is generally used in the West). This research is concerned with two major issues. The first is to consider the strategic employment of the Soviet fleet in nuclear war and deterrence involving the Soviet and American homelands. Second, an important by-product is the creation of a better methodology for analyzing the Soviet Navy. The new methodology will be tested by consideration of these deterrence and war roles.

22737 **(DOE/ER/30050—T1) Study to develop educational products about the fear of new energy technologies. Phase II.** DuPont, R.L. (DuPont Associates, Rockville, MD (USA)). 31 Jan 1985. Contract FG05-83ER30050. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85008670.

Fear of nuclear power was found in the study sample to be widespread and far more intense than fear of any other energy source. Fears were greatest of waste disposal and accidents, with fear of what is not known being especially common. Many fears appeared to be based on lack of information. Both general and specific fears of nuclear power were significantly reduced by reading an educational booklet. After reading this booklet study subjects reported less extreme views of nuclear power, seeing it to be more similar to other energy sources. This decline in fear of nuclear power did not produce a proportionate increase in support for nuclear power as a source of electricity.

2908 Waste Heat Utilization

22738 **(ANL/CNSV-TM—155) Macroeconomic effects under the proposed District Heating and Cooling Tax Incentives Act of 1982. Technology-related policy evaluation using a market penetration model and a macromodel.** Teotia, A.P.S.; Poyer, D.A. (Argonne National Lab., IL (USA)). Aug 1983. Contract W-31-109-ENG-38. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010185.

In its energy conservation programs, the US Department of Energy (DOE) has supported research into and development of district heating and cooling systems to meet energy demands in the residential and commercial sectors. Toward this goal, DOE requested Argonne National Laboratory to estimate the macroeconomic effects of the Senate bill known as the "District Heating and Cooling Tax Incentives Act of 1982." The first step was to estimate market penetration of district heating and cooling cogeneration energy systems under the provisions of the proposed act, using Argonne's district heating and cooling market penetration model. This model provided annual estimates of district heating and cooling investment and energy savings. In the second step, macroeconomic effects of district heating and cooling under the Act's provi-

sions were estimated using the annual model of the US economy developed by Data Resources, Inc. The conclusion is that district heating and cooling penetration under the Act could have significant favorable effects on gross national product, US employment, fuel import costs, and similar factors. The analysis assumes that district heating and cooling can overcome the institutional and environmental barriers that have impeded it in the past. 16 references, 17 figures, 13 tables.

22739 **(DOE/CS/40403—1) Industrial cogeneration potential (1980-2000) for application of four commercially available prime movers at the plant site. Volume 1. Summary. Final report.** (Dun and Bradstreet Technical Economic Services, Philadelphia, PA (USA); TRW Energy Development Group, Redondo Beach, CA (USA)). Aug 1984. Contract AC01-81CS40403. 190p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85007162.

Objective of the study was to provide details for the distribution of technically and economically feasible cogeneration opportunities by prime mover type, fuel consumed, and nameplate capacity, with cross-cuts according to location (state) and industrial sector. Thirteen combinations of prime mover/fuel type were considered: steam turbines (coal, residual oil, distillate oil, natural gas), gas turbines (residual oil, distillate oil, natural gas), gas turbine combined cycle systems (residual oil, distillate oil, natural gas), and diesel engines (residual oil, distillate oil, natural gas). The cogeneration systems investigated all represent commercially available, state-of-the-art technology.

22740 **(DOE/CS/40403—2) Industrial cogeneration potential (1980-2000) for application of four commercially available prime movers at the plant site. Volume II. Industrial cogeneration potential for application of steam turbines. Final report.** (Dun and Bradstreet Technical Economic Services, Philadelphia, PA (USA); TRW Energy Development Group, Redondo Beach, CA (USA)). Aug 1984. Contract AC01-81CS40403. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85007163.

This volume provides national, regional, and state profiles for potential (over and above the existing) steam turbine cogeneration plants within the United States. Included in this volume are two sets of computer printout tables for each state and for the Nation that presents: The total number of the best steam turbine cogeneration applications aggregated at the state and national levels and tabulated by two-digit SIC* group and system size range (52 tables), and the total electric nameplate capacity (MW) of the best steam turbine congeneration applications aggregated at the state and national levels and tabulated by two-digit SIC group and system size range (52 tables). The regional summary presented in this report provides the total number of potential plant sites and potential power generation (MW) by region.

22741 **(DOE/CS/40403—4) Industrial cogeneration potential (1980-2000) for application of four commercially available prime movers at the plant site. Volume 4. Industrial cogeneration potential for application of gas turbine combined cycle systems and diesel engines. Final report.** (Dun and Bradstreet Technical Economic Services, Philadelphia, PA (USA); TRW Energy Development Group, Redondo Beach, CA (USA)). Aug 1984. Contract AC01-81CS40403. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85007165.

This volume provides national, regional, and state profiles for potential gas turbine combined cycle and diesel cogeneration plants (over and above the existing) within the United States. Included in this volume are results of analysis for each state and for the Nation to determine: the total number of the best gas turbine combined cycle and diesel cogeneration applications aggregated at the state and national levels, and according to two-digit SIC group and system size range, and the total electric nameplate capacity (MW) of the best gas turbine combined cycle and diesel cogeneration applications aggregated at the state and national levels, and according to two-digit SIC group and system size range.

2910 Conservation

REFER ALSO TO CITATION(S) 29100022799, 22815

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 29200022727

22742 **(DOE/EIA—M005) Documentation of the integrating module of the intermediate future forecasting system.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Mar 1985. 131p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85010938.

This report describes the central integrating module (MAIN) in the Intermediate Future Forecasting System (IFFS) that was used to produce the energy forecasts published in the Annual Energy Outlook 1984. IFFS is a partial equilibrium model of the energy markets. The model consists of four supply modules, a stock module, a macroeconomic module, five demand modules, and the central integrating module whose primary function is to direct the execution sequence of the other modules. A brief description is given of the total system, but the focus of the report is on the integrating module. In addition, three supporting programs for IFFS, the database, the run submission, and the reporting systems are described briefly. 23 references, 5 figures.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 29400022331, 22372, 22372, 22373, 22376, 22376, 22388, 22389, 22394

22743 **(BNL—35957-Vol.3) Model documentation of the gas analysis modeling system. Volume 3. Software and data documentation and user's guide.** Kydes, A.S. (Brookhaven National Lab., Upton, NY (USA)). Aug 1984. Contract AC02-76CH00016. 301p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85009757.

This is Volume 3 of three volumes of documentation for the Gas Analysis Modeling System (GAMS) developed by the Analysis and Forecasting Branch, Reserves and Natural Gas Division, Office of Oil and Gas, Energy Information Administration (EIA), US Department of Energy. The documentation has been developed to comply with the requirements specified in Energy Information Administration Order EI 5910.3A, Guidelines and Procedures for Model and Analysis Documentation, effective Otober 1, 1982. Volume 3 is intended to satisfy (along with the model archive tape) the requirements of paragraph 5.c(2), 5.c(4) and 5.c(5) of the Order. The archive tape is denoted by the acronym GAMS83 and contains the version of GAMS used for the 1983 Annual Energy Outlook. Volume 3 describes this version of the software in detail.

2960 Electric Power

REFER ALSO TO CITATION(S) 29600022511, 23106

22744 **(DOE/BP—262-Vol.1) Larvick, S.L. BPA digital telecommunication projects, 1976-1983. Volume 1.** (USDOE Bonneville Power Administration, Portland, OR. Office of Engineering and Construction). Jun 1984. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008022.

This document describes in detail, work accomplished under three digital telecommunication projects. In-depth discussion on each project of this document has been furnished to serve as a complete reference source for digital telecommunication engineering criteria which is still to be formulated. The Digital Multiplex Prototype Project (Section 3) was a small R and D study performed within BPA examining the performance and possible application of digital multiplex equipment with existing BPA analog microwave facilities. Hanford-DOE (Section 4) and Portland-Ross New Computer System (NCS) (Section 5) digital microwave projects were line projects with rigid performance requirements. Although these

two projects are independent from BPA's extensive Power System Control (PSC) operational microwave network, the experience gained will be invaluable as PSC digital telecommunication opportunities develop.

22745 **(DOE/EIA—0455(83)) Historical plant cost and annual production expenses for selected electric plants, 1983.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 8 Apr 1985. 250p. NTIS, PC A11/MF A01 - GPO; GPO Dep. File Number DE85010006.

Information on the historical plant cost and annual power production expenses for selected hydroelectric-fossil-fueled steam-electric, gas-turbine, and nuclear steam-electric plants is provided for the year 1983. Some summary data are provided for each year from 1973 through 1983. Historical plant cost is the initial investment in plant (cumulative to the start of commercial operation), plus the cost of all additions to the plant, less the value of retirements. Thus these costs include expenditures made over several years. Power production expenses include operation, maintenance, and fuels. Also reported are data on installed generating capacity, net generation, net capability, fuel consumption, and physical plant characteristics. Data and narrative discussions on each type of power plant are contained in separate chapters. Plant-level data are arranged alphabetically by state, utility, and plant. This publication combines the following: Thermal-Electric Plant Construction Cost and Annual Production Expenses (DOE/EIA-0323) and Hydroelectric Plant Construction Cost and Annual Production Expenses (DOE/EIA-0171). Because the criteria for selecting the plants to be reported in the present publication have changed, data for previous years are not directly comparable to data for 1983. A glossary and technical notes are included. 5 figures, 18 tables.

22746 **(DOE/NBM—5009034) Power marketing: Great Lakes Area.** (USDOE Bonneville Power Administration, Portland, OR). Aug 1981. 81p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009034.

This report reveals that about 2.6 million kW of hydroelectric capacity could be installed at dams now operated by the US Army, Corps of Engineers (Corps) in the area comprising all of the States of Illinois, Indiana, Michigan, Ohio, and Wisconsin, and parts of Iowa, Minnesota, Pennsylvania, and West Virginia. A study of preference customers in the Great Lakes Area shows that their current loads total almost 10 million kW - five times the potential hydroelectric generating capacity of the area. This study supports the general conclusion that the hydroelectric potential at existing navigation and flood control projects in the Great Lakes area could be readily marketed. Federal power generated at these projects would be marketed by the Department of Energy (DOE) under provisions of the Flood Control Act of 1944. A recent sampling of the attitudes of specific preference customers in Iowa, Illinois, Indiana, Ohio, Michigan, and Wisconsin discloses that they are willing to commit themselves now to the purchase of such generation based on preliminary estimates of power costs developed by the National Hydroelectric Power Study.

22747 **(EPRI-EA—3805-Vol.1) Residential load forecasting for small utilities. Volume 1. Reference guide. Final report.** Mayo, G. (Burns and McDonnell Engineering Co., Kansas City, MO (USA)). Jan 1985. 172p. Research Reports Center, Box 50490, Palo Alto, CA 94303 $17.50. File Number TI85920548.

These step-by-step procedures can help small utilities develop their own tools for forecasting residential electricity sales. Written in a clear and informative style, the guide is intended for utility personnel with little or no training in load forecasting and statistics.

22748 **(EPRI-EA—3857-CCM) User's guide to the Regionalized Electricity Model.** Baughman, M.; Panjevan, S. (Southwest Energy Associates, Inc., Austin, TX (USA)). Jan 1985. 270p. Research Reports Center, Box 50490, Palo Alto, CA 94303 $23.50. File Number TI85920551.

Computer code manual.

This manual is designed to help users interact with the Regionalized Electricity Model (REM). The intent of the document is to facilitate a general understanding of the overall REM structure and a detailed appreciation of the REM subprogram capabilities. With physical access to the proper facilities, this manual will further assist the user in actually engaging the informed model exercises. However, like most such manuals, this one would be used in conjunction with the program coding itself.

22749 **(EPRI-EL—3893) Multiple factoring in the parallel solution of algebraic equations. Final report.** Van Ness, J.E. (Northwestern Univ., Evanston, IL (USA)). Mar 1985. 56p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920573.

Many power system simulations call for solving large sets of simultaneous algebraic equations. A new multiple factoring algorithm for use in parallel processing requires fewer calculations than past algorithms, thereby reducing computation time and costs for utility multiprocessor networks.

22750 **(TVA/PE/INFO—85/19) Power program summary, Volume II. 1984 financial and statistical report for municipal and cooperative distributors of TVA power, fiscal year ending June 30, 1984.** (Tennessee Valley Authority, Chattanooga (USA)). 1985. 57p. NTIS, PC A04/MF A01. File Number DE85900613.

This report reflects the operations of those distributors during their fiscal year ending June 30, 1984. TVA gathered the data from annual reports and other material prepared by each of the 160 distributors.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 29800022742

2990 Unconventional Sources And Power Generation

22751 **(DOE/RA/50094—T1) Geothermal energy planning and communication for native Americans. Final report. Draft.** Robertson, T.A. (Robertson (Thomas A.), Washington, DC (USA)). 30 Mar 1982. Contract FG01-80RA50094. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85009800.

The purpose was to explore and develop geothermal energy resources on Indian lands. Activities included the following: (1) continued review of Indian communities and their potential for geothermal energy development; (2) introduced tribes to the availability of geothermal energy and removed the barriers to the implementation of this energy source; (3) provided information by telephone and by mailing packages of information; (4) published articles on geothermal energy development in the UIPA newsletter and supplied articles to other Indian publication; (5) conducted two seminars specific to geothermal energy development on Indian lands in western states; (6) carried out survey of Indian attitudes and opinions toward energy in general and geothermal energy in specific; (7) incorporated geothermal energy development information in Economic Development Administration sponsored tribal government management programs, and (8) developed draft written material addressing Indian planning problems and supporting their ability to affect a more productive working relationship with government agencies and reduced dependency.

22752 **(ENV-MER—81-188) Systematic aspects of natural resources and solar energy development in the Mediterranean energy region.** Grenon, M. (Ministere de l'Urbanisme et du Logement, 75 - Paris (France)). Jul 1982. 103p. (In French). NTIS (US Sales Only), PC A06. File Number DE85751005.

After some reflections on the possible extensions and the systematic aspects of natural resources, a global review of natural resources (water energy, materials and space territory) for countries bordering on the Mediterranean sea is presented. Then one shows quantitative examples of analysis of natural resource needs for solar energy development. Mediterranean resources are comparatively rare, and solar energy development may use much of these, what may lead to conflicts. The last part deals with the methodology to settle these conflicts; after a recall of some principles on the scien-

tific aid to decision, theoretical and practical aspects of usefulness or priority functions are presented.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

22753 (DOE/ET/10815—98) User's Manual for the UTSI MHD/steam power plant Systems Code. Chapman, J.N.; Kiessling, E.H.; Altstatt, M.C.; Prather, C.D. (Tennessee Univ., Tullahoma (USA). Space Inst.). Jan 1985. Contract AC02-79ET10815. 115p. (UTSI—85-01). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85007770.

This report is a User's Manual for the UTSI Systems Code for analysis of the cost/performance of combined cycle MHD steam power plants. In addition to the original code, it contains the NASA SP-273 code for chemical equilibrium calculations and PRESTO steam plant code which was originated by the General Electric Company and modified by Oak Ridge National Laboratories and NASA. This document describes the new code and its application but does not attempt to reproduce the documents describing the SP-273 and PRESTO codes. A new one-dimensional generator code is provided which was developed from other UTSI codes specifically for integration into this Systems Code. An alternative is provided so that the user can enter the required generator characteristics from an external calculation. The report describes the required inputs and outputs produced. It also describes the calculational methodology so that a potential user can modify or expand any calculation as required. New and substantially modified code is provided in the appendices, along with sample inputs and outputs.

22754 (DOE/PC/70507—2) MHD channel development. Quarterly report, July-September 1984. (Avco-Everett Research Lab., Everett, MA (USA)). Nov 1984. Contract AC22-84PC70507. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008305.

The modelling of the diagonal channel with resistive links was completed. A second series of LDV experiments was conducted on the Avco Mk VI channel using diagnostics provided by Mississppi State University. A long-duration test of the Mk VII channel with the objective of side-wall development is in progress. Electrode drops in the Mk VI Reference Channel No. 4 operating without slag were measured, over a range of gas conductivities and magnetic field strengths. A set of master/slave current consolidation and control circuitry was tested for 40 hours on the Mk VII channel. The testing is continuing in parallel with the long-duration sidewall testing in progress under Task 2. The Mk VI and Mk VII test facilities were operated for a total of 73 hours: power was generated for 30 hours. The supersonic section of the Reference 4 diffuser was reworked to allow simultaneous use of the stagnation pressure probe and the LDV. Shim plates were added to the Mk VI magnet. 2 references, 32 figures.

22755 (DOE/PC/70508—T2) Coal-Fired MHD Combustor Development Project: Phase IIID. Third quarterly technical progress report, November 1, 1984-January 31, 1985. (TRW Energy Development Group, Redondo Beach, CA (USA)). 20 Feb 1985. Contract AC22-84PC70508. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008822.

This third quarterly technical progress report of the Coal-Fired MHD Combustor Development Project (Phase IIID) presents the accomplishments during the period 1 November 1984 to 31 January 1985. The scope encompasses development work on the 50 MW/sub t/ combustor related to test support at the CDIF, fabrication and assembly of first and second stoge hardware, plans for second stage design vertification testing and power testing, and designs for a continuous slag rejector and low preheat inlet section. Progress included the following: Operational verification testing of the first stage at the CDIF was completed (A total of 38 tests were conducted); assembly and checkout of the second first stage, two second stages, and PEM was 75 to 90% completed; conceptual designs for a continuous slag rejector and low preheat inlet section were completed and low preheat preliminary design work was 75% completed; and revision of the Users' Manual to include the second stage was 75% completed and a draft Test Plan for power train testing was prepared and reviewed. 13 figures, 7 tables.

22756 (STDR—85-7) [Advanced Power Train quarterly report, January-March 1985]. (Standard Research Corp., Arcadia, CA (USA)). 1985. Contract AC22-83PC60576. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008211.

STD Research Corporation carried out analyses in support of the Advanced Power Train program, the Avco high interaction experiments, the MHD-induced secondary flow measurements at Stanford University, and the proof-of-concept demonstration at CDIF. STD Research Corporation analyzed three-dimensional simulations of the finalized design of the 500 MW(th) powertrain specified by the Westinghouse APT team. These preliminary simulations: (1) indicated superiority of the conducting sidewall to the insulating sidewall in overall performance and suppression of magnetoaerothermal effects; and (2) indicated the presence of substantial heat flux asymmetries between the anode and cathode walls of the duct due to magnetoaerothermal effects. Work continued on the analysis of the APT design developed by the General Electric APT team. STD Research Corporation has limited its three-dimensional analysis of the Mark VI experiments to simulations of data already obtained. Neither the simulations nor the experimental data indicate the formation of the kind of strong current constriction on either electrode that was observed in the STD prediction and subsequent observations at the AEDC High Performance Demonstration Experiment. However, the simulations clearly show the same heat transfer asymmetry exhibited by the APT three-dimensional results, as well as the simulations of Stanford and CDIF experimental conditions described below. The predictions of heat transfer asymmetries are verified by the Avco experiments.

22757 (DOE-tr—273-Vol.1) Eighth international conference on MHD electrical power generation. Volume 1. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). 1983. Translation source information not available . (CONF-830906—Vol.1-Trans.). 441p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85007039.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

The proceedings of the VIIIth International Conference on MHD Electrical Power Generation contain the results of most recent R and D work aimed at practical realization of this advanced method of electrical power generation. The papers presented to the Conference deal with heat-generating schemes and cycles, conceptual and detail designs of MHD power plants, including that of the first commercial 500-MW power-generating unit presently under construction in the USSR. Research results are described obtained in pilot and experimental facilities in the USSR, USA, Poland, Japan, Netherlands and other countries. This volume contains 44 papers arranged under the following session headings: conceptual designs, scheme analysis and mathematical modeling of MHD power plants; experimental and pilot MHD facilities; testing, designing and modeling of MHD channels; and electrode phenomena and plasma processes.

22758 (DOE-tr—273-Vol.2) Eighth international conference on MHD electrical power generation. Volume 2. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). 1983. Translation source information not available . (CONF-830906—Vol.2-Trans.). 414p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE85007038.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

The proceedings contain the results of most recent R and D work aimed at practical realization of this advanced method of electrical power generation. The papers presented to the Conference deal with heat-generating schemes and cycles, conceptual and detail designs of MHD power plants, including that of the first commercial 500-MW power-generating unit presently under construction in the USSR. Research results are described obtained in pilot and experimental facilities in the USSR, USA, Poland, Japan, Netherlands and other countries. This volume contains 46 papers arranged under the following session headings: MHD flows and

electromagnetic field; heat transfer in channel and working medium; and MHD components (loading system, magnet).

3005 Fuel Cells

REFER ALSO TO CITATION(S) 30050022280, 22475

22759 (ANL—84-64) Advanced fuel cell development. Progress report, January-March 1984. Pierce, R.D.; Baumert, B.; Claar, T.D.; Fousek, R.J.; Huang, H.S.; Kaun, T.D.; Krumpelt, M.; Minh, N.Q.; Mrazek, F.C.; Poeppel, R.B. (Argonne National Lab., IL (USA)). Jan 1985. Contract W-31-109-ENG-38. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009662.

This report describes fuel cell research and development activities at Argonne National Laboratory (ANL) during the period January through March 1984. These efforts have been directed principally toward seeking alternative cathode materials to NiO for molten carbonate fuel cells. Based on an investigation of the thermodynamically stable phases formed under cathode conditions, a number of prospective alternative cathode materials have been identified. From the list of candidates, $LiFeO_2$, Li_2MnO_3, and ZnO were selected for further investigation. During this quarter, they were doped to promote conductivity and tested for solubility and ion migration in the cell environment. These tests showed that Li_2MnO_3 and $LiFeO_2$ are attractive; further work is being done to better understand the conductivity of these materials; ZnO has proved to be too soluble for further consideration. An investigation directed to understanding in-cell densification of anode materials was initiated. In addition, calculations were made to evaluate the practicality of controlling sulfur accumulation in molten carbonate fuel cells by bleed-off of a portion of the anode gas that could be recycled to the cathode. In addition, a model is being developed to predict the performance of solid oxide fuel cells as a function of cell design and operation. 2 references, 33 figures, 10 tables.

22760 (DOE/METC—85/15) Fuel cells. A bibliography. Kinser, W.H. (ed.). (USDOE Morgantown Energy Technology Center, WV; USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Apr 1985. 436p. (DOE/TIC—3359-Suppl.2). NTIS, PC $23.00/MF A01; GPO Dep. File Number DE85004565.

This compilation includes approximately 1900 citations of foreign and domestic reports, journal articles, patents, conference papers and proceedings, monographs, and books. The citations were taken from the DOE Energy Data Base covering the period July 1980 through February 1985. The citations are arranged in subject categories as shown in the table of contents. Within each category the report citations are arranged alphanumerically by report number, and nonreport literature citations are arranged in reverse chronological order. Corporate Author, Personal Author, Subject, Contract Number, and Report Number indexes are provided. This bibliography is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information on fuel cells prior to July 1980 is included in reports TID-3359 and TID-3359(Suppl-1) which are also available from NTIS.

22761 (N—85-11455) Electrocatalysis of fuel cell reactions: investigation of alternate electrolytes. Final report. Chin, D.T.; Hsueh, K.L.; Chang, H.H. (Clarkson Coll. of Tech., Potsdam, NY (USA)). Jan 1984. 114p. (NASA-CR—174753; DOE/NASA—0238-1). NTIS, PC A06/MF A01.

Oxygen reduction and transport properties of the electrolyte in the phosphoric acid fuel cell are studied. The areas covered were: (1) development of a theoretical expression for the rotating ring disk electrode technique, (2) determination of the intermediate reaction rate constants for oxygen reduction on platinum in phosphoric acid electrolyte, (3) determination of oxygen reduction mechanism in trifluoreomethanesulfonic acid (TFMSA) which was considered as an alternate electrolyte for the acid fuel cells, and (4) the measurement of transport properties of the phosphoric acid electrolyte at high concentrations and temperatures.

22762 (N—85-13371) Regenerative fuel cell energy storage system for a low Earth orbit space station. Martin, R.E.; Garow, J.; Michaels, K.B. (United Technologies Corp., South Windsor, CT (USA)). Aug 1984. 146p. (NASA-CR—174802). NTIS, PC A07/MF A01.

Results of a study to define the characteristics of a regenerative fuel cell energy storage system for a large space station operating in low earth orbit (LEO) are presented. The regenerative fuel cell system employs an alkaline electrolyte fuel cell with the option of employing either an alkaline or a solid polymer electrolyte electrolyzer.

22763 (PB—85-151322/XAB) Follow-on 40-kW field test support. Annual report, July 1983-June 1984. Staniunas, J.W.; Merten, G.P.; Smith, R.M. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Aug 1984. 123p. (FCR—6494). NTIS, PC A06/MF A01.

With the delivery of the first nine 40-kW fuel-cell power plants completed in early 1984, the fuel-cell field-test project has moved into the power-plant test phase. The activities of the past year concentrated on supporting the utilities in the selection of field-test sites through instrumented site data analyses, Final Site Selection Report (FSSR) reviews, and the review of fuel-cell site installation drawings. As of June 1984, hourly electrical and thermal systems data were monitored at 71 candidate sites and 7 fuel-cell test sites. The initial power-plant data shows that electrical efficiencies of 40% and overall efficiencies of 80% were achieved in a variety of field applications. These data are supporting application analysis beyond the specifics of the individual field test sites. Approaches were developed for characterizing site energy requirements with a limited amount of hourly data. Comparison of a simplified technique for evaluating on-site fuel-cell systems with detailed hands-on analysis confirmed the validity of these approaches. Analysis of fuel-cell sizing and operating modes has provided a better understanding of its impact on utility revenues, gas sales and customer savings. These application analyses are useful in establishing power-plant technical requirements and providing focus for utility market and application assessments.

22764 (PB—85-155976/XAB) Fuel-cell reaction in super acid electrolytes. Final report, June 1983-June 1984. O'Grady, W.E. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. 27p. NTIS, PC A03/MF A01.

See also PB84-160969.

The series of acids including $HN(SO_2CF_2O_2(CF_2)_4(SO_3H)_2$, $n\text{-}C_4F_9SO_3H$ and $CH_3PO(OH)_2$ were examined as possible fuel cell electrolytes. The reduction of oxygen in $HN(SO_2CF_2O_2$ and $(CF_2)_4(SO_3H)_2$ is similar to that achieved in 4M KOH. The activity for oxygen reduction in the $n\text{-}C_4F_9SO_3H$ does not appear to be as high as found for other sulfonic acids studied. At this time, it is not clear whether or not this behavior is attributable to impurity effects. It appears that the superfluorosulfonic acids which contain CF_2 groups tend to wet Teflon. In $CH_3PO(OH)_2$ oxygen reduction was similar to that in phosphoric acid; however, the data were not reproducible, probably due to the water content of the acid.

22765 Solid electrolyte structure. Fraioli, A.V. (to Dept. of Energy). US Patent 4,477,541. 16 Oct 1984. Filed date 22 Dec 1982. vp.

PAT-APPL-452361.

A solid electrolyte structure for fuel cells and other electrochemical devices providing oxygen ion transfer by a multiplicity of exposed internal surfaces made of a composition containing an oxide of a multivalent transition metal and forming small pore-like passages sized to permit oxygen ion transfer while limiting the transfer of oxygen gas.

22766 Solid oxide fuel cell having monolithic cross flow core and manifolding. Poeppel, R.B.; Dusek, J.T. (to Dept. of Energy). US Patent 4,476,196. 9 Oct 1984. Filed date 12 Oct 1983. vp.

PAT-APPL-541177.

This invention discloses a monolithic core construction having the flow passageways for the fuel and for the oxidant gases extended transverse to one another, whereby full face core mani-

folding can be achieved for these gases and their reaction products. The core construction provides that only anode material surround each fuel passageway and only cathode material surround each oxidant passageway, each anode and each cathode further sandwiching at spaced opposing sides electrolyte and interconnect materials to define electrolyte and interconnect walls. Webs of the cathode and anode material hold the electrolyte and interconnect walls spaced apart to define the flow passages. The composite anode and cathode wall structures are further alternately stacked on one another (with the separating electrolyte or interconnect material typically being a single common layer) whereby the fuel passageway and the oxidant passageways are disposed transverse to one another.

22767 **Solid oxide fuel cell having a monolithic core.** Ackerman, J.P.; Young, J.E. (to Dept. of Energy). US Patent 4,476,198. 9 Oct 1984. Filed date 12 Oct 1983. vp.
PAT-APPL-541213.

A solid oxide fuel cell for electrochemically combining fuel and oxidant for generating galvanic output, wherein the cell core has an array of electrolyte and interconnect walls that are substantially devoid of any composite inert materials for support. Instead, the core is monolithic, where each electrolyte wall consists of thin layers of cathode and anode materials sandwiching a thin layer of electrolyte material therebetween, and each interconnect wall consists of thin layers of the cathode and anode materials sandwiching a thin layer of interconnect material therebetween. The electrolyte walls are arranged and backfolded between adjacent interconnect walls operable to define a plurality of core passageways alternately arranged where the inside faces thereof have only the anode material or only the cathode material exposed. Means direct the fuel to the anode-exposed core passageways and means direct the oxidant to the cathode-exposed core passageway; and means also direct the galvanic output to an exterior circuit. Each layer of the electrolyte and interconnect materials is of the order of 0.002-0.01 cm thick; and each layer of the cathode and anode materials is of the order of 0.002-0.05 cm thick.

22768 **Integral manifolding structure for fuel cell core having parallel gas flow.** Herceg, J.E. (to Dept. of Energy). US Patent 4,476,197. 9 Oct 1984. Filed date 12 Oct 1983. vp.
PAT-APPL-541178.

Disclosed herein are manifolding means for directing the fuel and oxidant gases to parallel flow passageways in a fuel cell core. Each core passageway is defined by electrolyte and interconnect walls. Each electrolyte and interconnect wall consists respectively of anode and cathode materials layered on the opposite sides of electrolyte material, or on the opposite sides of interconnect material. A core wall projects beyond the open ends of the defined core passageways and is disposed approximately midway between and parallel to the adjacent overlaying and underlying interconnect walls to define manifold chambers therebetween on opposite sides of the wall. Each electrolyte wall defining the flow passageways is shaped to blend into and be connected to this wall in order to redirect the corresponding fuel and oxidant passageways to the respective manifold chambers either above or below this intermediate wall. Inlet and outlet connections are made to these separate manifold chambers respectively, for carrying the fuel and oxidant gases to the core, and for carrying their reaction products away from the core.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

22769 **(PNL-SA—12865) Tribological sinks: money down the drain.** Imhoff, C.H. (Pacific Northwest Labs., Richland, WA (USA)). [1985]. Contract AC06-76RL01830. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010019.

The Energy Conversion and Utilization Technologies (ECUT) Program in US DOE initiated a program to study tribology and how to reduce friction and wear. ECUT conducted six surveys to gather information about the tribology problem in USA: review of tribological sinks in six major industries, reduction in tribological energy losses in the transportation and electric utilities sectors, assessment of government tribology programs, assessment of industrial attitudes toward generic research needs in tribology, identification of tribological R and D needs for lubrication of advanced heat engines, and energy conservation potential of surface modification technologies. Results of these surveys are summarized in this paper. (DLC)

22770 **(BG-Trans—6353) Saving energy with the aid of flue gas condensation.** Stadelmann, M. Translated from *Waerme ;* 32: No. 1, 34-39(Jan 1983). 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900558. DE85900558

The moisture content of fuels undergoing combustion is caused to evaporate. The energy required for evaporation can be largely recovered if the combustion products leaving the furnace are cooled down to such an extent as to cause the water vapor to condensate. This is accomplished in condensing recuperators arranged downstream from the heat-generating units or on heat exchange surfaces forming an integral part of the boiler (condensing boiler). The author describes the development of such boilers and recuperators and outlines the problems that may be encountered in their installation and operation.

3201 Buildings

REFER ALSO TO CITATION(S) 32010022501, 22502, 22503, 22575, 22738, 23091

22771 **(AD-A—147893/2/XAB) Hangar heating and energy-conservation manual. Final report, October 1979-September 1983.** Ashley, J.L. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Sep 1984. 110p. NTIS, PC A06/MF A01.

Hangars and similar structures require large amounts of energy for space heating. Energy-conservation survey techniques for hangars are defined and technical data sheets are included which provide: (1) procedures to identify energy-conservation deficiencies; (2) methods to calculate annual energy losses; (3) recommend solutions; and (4) methods to calculate annual energy savings.

22772 **(DOE/CE/64827—T2) Study of methods to stimulate private investment in hospital energy conservation. Final report.** Morrow, M.J.; Schooler, G.J.; Maturi, R.A.; Raichel, T.M. (Blue Cross and Blue Shield Association, Chicago, IL (USA)). 1984. Contract FG01-82CE64827. 314p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85003100.

Hospital energy conservation can address two societal concerns - persistent health care cost inflation and excessive energy use. While hospitals can achieve some energy savings by implementing no-cost or low-cost changes in building operations and maintenance, substantial additional savings can be achieved by investing in energy conservation capital projects. In recent years, non-profit hospitals have received assistance in financing these capital projects from the Department of Energy schools and hospitals matching grants program. The DOE program, however, has experienced substantial funding cutbacks. To continue widespread implementation of hospital energy conservation capital projects, greater private sector investment will be required. The Blue Cross and Blue Shield Association and DOE conceived the Study of Methods to Stimulate Private Investment in Hospital Energy Conservation to facilitate increased hospital energy conservation investment through private sector initiatives. The focus of the study was energy conservation investment by private, non-profit hospitals. These hospitals constitute the largest segment of the hospital industry. Many of the findings about energy conservation investment in private, non-profit hospitals also apply to government-owned and investor-owned hospitals. The major findings are as follows: A major opportunity exists to achieve widespread hospital energy conservation investment over the next five to ten years; private sector financing arrangements represent a means of realizing this opportunity; several factors presently inhibit hospitals and investors from entering into energy conservation financing transactions; and state and federal initiatives can help create an environment more conducive to private financing of hospital energy conservation.

22773 **(DOE/CS/20435—T1) Importance of the built environment to the quality of American life: proceedings of the Building Research Advisory Board's 1977 building futures forum.** Wiggins, J.H.; Hamilton, C. (National Research Council, Washington, DC (USA). Building Research Advisory Board). 1980. Contract FG01-77CS20435. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85010201.

The Building Research Advisory Board (BRAB) convened its 1977 Building Futures Forum on the Importance of the Built Environment to the Quality of American Life: to call attention to the complex relationship between the man-built environment and individual and societal health and well-being; to identify issues that can be expected to have a major impact on the built environment and the building community in the years ahead; and to explore alternative approaches for improving the quality of American life through modification, development, and application of building technology. In planning the Forum, BRAB and its Technology Assessment and Utilization (TAU) group recognized that the vast majority of Americans spend the greatest portion of their lives in the built or enclosed environment (i.e., homes, offices, factories, and schools) but that most of the attention given to improving the quality of life by creating a better environment has been concentrated on the natural or outdoor environment. With this in mind, the 1977 Forum was organized to permit a broad group of specialists in many disciplines to share their expertise and to devote their energy to the development of an agenda of feasible and high-priority research and action concerning four major topics: future settlement patterns, energy utilization and building technology, health and human development, and policy demands on the building community.

22774 **(DOE/CS/60014—7) Instruction manual: school energy auditing test equipment.** (Minnesota Dept. of Energy and Economic Development, St. Paul (USA). Energy Div.). Aug 1984. Contract FG02-76CS60014. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010148.

This manual provides instructions on the use of the following energy auditing test equipment: ultrasonic troubleshooter, digital thermometer and light meter, boiler combustion test kit, combustion efficiency charts, and boiler water test equipment. Blank forms are also included. (DLC)

22775 **(DOE/CS/60014—8) Identifying low cost energy improvements for school buildings: an energy audit manual.** (Minnesota Dept. of Energy and Economic Development, St. Paul (USA). Energy Div.). 1984. Contract FG02-76CS60014. 96p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010147.

This manual is a guide for identifying low and no cost opportunities to save energy dollars in school buildings. It is a workbook for school maintenance and administrative personnel to use to conduct a walk-through inspection of a school building, focusing on the energy efficiency of its equipment and operations. It is geared primarily toward buildings that house primary and secondary grades and community centers. Although it was written for public and private schools, other organizations with similar buildings, such as college classroom buildings, should also find the manual useful. Only energy conservation opportunities that have proven to be effective in schools are included. The energy conservation measures included here are based on a study of 39 school buildings that analyzed the effectiveness of mini-audits previously conducted on the buildings. The study found that carrying out a program of low and no cost conservation measures is effective in cutting energy use. The schools studied had reduced their energy consumption an average of about 10% by carrying out many of the measures identified in their original mini-audit. A mechanical engineer reaudited each building and found several opportunities that had not been identified in the previous audit. The study concluded that if the schools carried out all of the measures identified in the original mini-audit, as well as those identified in the second audit, even greater savings could be achieved. The measures recommended are those that were identified most frequently in this study as being conservation opportunities to save energy in audited school buildings. 16 references.

22776 **(DOE/ER/10275—1B, pp 40) Heat pump systems analysis.** Pazooki, N. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

22777 **(DOE/R3/02408—T1) Geocoolant energy conservation and recycling system. Final report, period ending August 31, 1982.** (Mount Saint Mary's Coll., Emmitsburg, MD (USA)). 1982. Contract FG43-80R302408. 33p. NTIS MF A01; 2; GPO Dep. File Number DE85008994.

On August 25, 1982, final connections were made to the cooling coil and the geocoolant system is now completely installed. The system, as I am happy to report, is operating not only effectively but also efficiently. It is safe to conclude that the principle of using spring water for cooling is valid and has commercial applications. Lessons learned from tests show that the following would increase system efficiency: (a) Establish fresh air damper controls to reduce outside air to 15% or less. Mixed air temperature should drop, reduce cooling demand and increase cooling efficiency of the geocoolant coil. (b) Relocate the geocoolant coil forward of the refrigeration coil to allow use of both when necessary to reduce space temperature. The result will reduce refrigerant coil demand and energy usage. (c) Insulate water carrying systems to reduce heat exchange prior to entry of water into the geocoolant coil. (d) Bury all water carrying systems below the frost line to reduce heat exchange during transport.

22778 **(DOE/R3/02412—T1) HOt Water SavEr (HOWSE) Project. Final report.** Olson, W.R. (Olson (Wayne R.), Catonsville, MD (USA)). 31 Dec 1981. Contract FG43-80R302412. 23p. NTIS, PC A02. File Number DE85009182.

The dishwasher effluent is pumped into the flue of the exchange tank by the normal dishwasher pump (or auxiliary pump). The effluent is stored in this tank until next operation of the dishwasher. Thus, thermal equilibrium can be reached between the tank and the effluent, promoting high efficiency. The output from the exchange tank feeds the household normal hot water tank, reducing its requirement for fuel as the input water temperature is higher. Counterflow exchangers may be used for other hot water users where the flow and drain is continuous. In this case the discharged hot (or warm) water flows counter to the flow of cold water into the hot water heater. The two flows are closely coupled thermally but not in direct contract so they cannot mix. Counter flow exchangers and storage type exchangers may be used in the same installation.

22779 **(DOE/R3/02414—T1) Fireplace boiler system. Final progress report.** DePalmo, C.R. (DePalmo (Charles R.), Delanco, NJ (USA)). [1985]. Contract FG43-80R302414. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009183.

The results showed that the fireplace boiler system can generate more heat than a conventional gas fired furnace (because of controls) and can generate higher temperatures at the various supply registers. In addition, the distribution of heat from the fireplace boiler system results in better thermal confort since the furnace fan is continuous rather than intermittent as in a conventional system. It is important to reiterate the fact that the system incorporates a pressure-temperature relief valve and an expansion tank to further alleviate any potential high temperature conditions. The second objective was partially fulfilled in view of the fact that, on a mild summer day (ambient temperature 83°F), the fireplace boiler system, operating on incoming service water (75°F) generated a cooling effect that could aid a conventional central air conditioning system in providing total house comfort. However, operating alone, only a ventilation effect could be generated. These results showed that with an ice pack, placed on the fireplace boiler, the water temperature rose 5°F, depicting the fact that heat transfer was taking place while the water in the system is being circulated. The information gained from these tests results leads one to believe that an ice pack chilled water system, adequately designed, constructed and insulated could be added to the existing fireplace boiler system and a total air conditioning effect could be obtained.

22780 (DOE/R3/02430—T1) Rehabilitate center city row home to increase its energy efficiency. Final report. Vinall, P.E. (Vinall (Phillip E.), Philadelphia, PA (USA)). 30 Sep 1981. Contract FG43-80R302430. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009266.

All of the proposals outlined in the grant have been completed, but 1/3 of the construction remains to be finished before the building can be considered habitable. Only after the building is made habitable can normal energy use be measured and evaluated. The building's energy efficiency has been increased, by how much the author cannot say at this point. The aesthetics of the building have not been sacrificed, however, and are consistent with the energy efficient features, i.e., nothing seems forced or out of place. Overall it is a practical design that appears workable and easily reproducible. This type of structure might appeal to those people now buying condominiums. That is, a single or couple desiring a low cost, energy efficient single family home in a city environment. It could also include a parking area as does this structure. Two features warrant further comment. An interesting study, as well as useful for further projects along this line, would be a computer study of air flow and wall-ceiling arrangements. The study could determine what wall and ceiling shapes promote the most efficient cooling and heating via air mass movement, artificially or passively. Before large roof fans (which are more cost efficient than air conditioners) can compete with air conditioning, a method of reducing fan noise should be found.

22781 (DOE/R3/02446—T1) Community demonstration of insulated window coverings. Final report. Averill, J. (Summers County Services Council, Hinton, WV (USA)). [1982]. Contract FG43-80R302446. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009210.

Work performed through the Community Demonstration of Insulated Window Coverings Department of Energy contract included installation of more than 750 square feet of window shades in public buildings throughout Summers County, West Virginia. Window quilts were constructed and placed in the three county senior citizens' centers, a fire department, the county courthouse, the county library, and one school. Energy savings payback from the use of these shades is expected to surpass the cost of the grant within the lifetime of the shades. Other results of the DOE-funded project have met the outlined purposes for which the undertaking was conducted. Community awareness of energy conservation was enhanced through workshops and favorable press coverage. Refinements in working mechanics of the shades and in quilting methods have been an outgrowth of the experimentation which took place. Most importantly, an on-going cottage industry has emerged and has legally incorporated as a producer's cooperative. Finally, the conception of combining traditional quilting skills with the need for energy conservation innovations is proving a natural marriage, as the West Virginia Department of Culture currently helps the co-op put finishing touches on the product. Installation of 17 large shades was slower than anticipated. Delays included unforeseen fire restrictions in assembly buildings, and the need for many design innovations. If it were not for supplemental labor provided through the Green Thumb Senior Employment Program, the budget could have never carried the task to completion. The greatest value of this project may lie beyond the 17 public building installations. The practical experience and design process resulting from the installations should lead to jobs paid for by selling the product that has evolved.

22782 (DOE/R3/02447—T1) Draft Reduction System. Final project report. Krock, R.P. (Krock (Richard P.), Huntington, WV (USA)). 26 May 1983. Contract FG43-80R302447. 88p. NTIS MF A01; 2; GPO Dep. File Number DE85008982.

The Draft Reduction System examined under the subject grant is classified as an energy conservation project that is intended to reduce heating costs for homes equipped with combustion type furnaces which utilize non-renewable type fuels such as natural gas or home heating oil. Conceptually the DRS reduces fuel consumption of a residential furnace by replacing volumes of inside heated air used to control furnace draft with volumes of unheated outside air. In practice, the amount of estimated fuel savings totaled 25 cents per year, thereby rendering the system to be cost ineffective. The cost for materials to install a DRS is some $50. The heart of the DRS is a quench air damper (QAD) which is a device installed in a chimney that allows air to short circuit the residence and directly enter the chimney in performing its function of excess furnace draft control. The system was installed in my residence on April 7, 1981 and testing was conducted during the subsequent two year period. The most accurate measurement technique is believed to be measurement of the flue gas temperature in the furnace vent pipe. A difference of 6.5°F was measured with the DRS functional compared with it inoperative. While the phenomena of draft reduction is observable in a residential furnace (as indicated by the above reported temperature differential) its magnitude is not sufficient to economically justify installation of the DRS. On a residential level, more productive use of capital is achieved with the installation of a modern high efficiency furnace as replacement of existing equipment becomes necessary. On an industrial scale, draft reduction systems are already in operation. Other general comments regarding the project are discussed; the General section and conclusions are expounded upon in the Conclusions section.

22783 (DOE/R3/06048—T1) [Improving the efficiency of the oil fired forced air furnace]. Guenthner, J.L. (Guenthner (John L.), Newark, DE (USA)). 20 Jul 1981. Contract FG43-79R306048. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009260.

Construction is complete and the system is in operation. The original system using once-through water as a heating medium, proved wasteful, so a closed-loop system circulating R-11 was designed. (DLC)

22784 (DOE/R3/06049—T1) Utilization of well water for heating and cooling. Kershner, V.V.; Sweeney, M.C. (Kershner (Vance V.), Lincoln University, PA (USA); Sweeney (Mark C.), Townsend, DE (USA)). Oct 1980. Contract FG43-79R306049. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009217.

The performance of a residential well-water-source heat pump was investigated. A comprehensive discussion of the operating principles is presented. Data was compiled which enables a direct comparison with both air-source units and oil furnaces. Results establish that well-water-source heat pumps are a viable alternative to conventional heating and cooling systems.

22785 (DOE/R3/06056—T1) Use and recycling of renewable water resources as an energy source on the coastal plain of Maryland, Delaware and Virginia. Summary report, September 1979-June 1981. Sylvester, D. (SYLCO, Inc., Berlin, MD (USA)). 1981. Contract FG43-79R306056. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009212.

The program was very successful in demonstrating the use of a ground water heat pump as an energy saving heat and air conditioning system for this area. The efficiency of the system has been demonstrated by numerous tests and it is well accepted that they have a coefficient of performance (C.O.P.) of 2.9 to 4.0, depending on the manufacturer and ambient conditions. This compares extremely favorably against a conventional air-to-air heat pump (C.O.P. = .95 to 1.9) or resistance heat (C.O.P. = .95). Both of these systems are in widespread use in this area. The resistance to the acceptance of this system until recently, hinged on three problems: lack of availability of ground water heat pump systems, difficulty in obtaining permits, and problems of disposing of large quantities of water at a residential site. The first problem has been overcome in the last year or two, since many manufacturers of heat pumps now market a ground water heat pump system, as well as several manufacturers who produce that system exclusively. The difficulty in obtaining permits tends to discourage many people who have accepted the advantages and economy of the system. The third problem was the object of this demonstration model. Water disposal from a ground water heat pump is traditionally by one or two methods: (1) discharge into a second well, or (2) discharge into a drainage ditch, storm drain, pond or other basin. This program has demonstrated that the discharged water can be disposed of very effectively by spray irrigation on a relatively small area most of which can be used to irrigate lawns, gardens or used

in numerous other ways. It is recommended that in order for this system to gain widespread acceptance and result in vast energy savings for the Delmarva area, the following must be done: simplify the procedure for obtaining permits, and educate the public to the potential energy savings and the economy of the system.

22786 **(DOE/R3/06086—T1) Unique wood-fired system for domestic hot water generation. Final report.** (Stone Family Dulcimers, Montrose, PA (USA)). Sep 1981. Contract FG43-79R306086. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009202.

This project has proven that it is possible to construct in a home workshop situation, a simple, durable, reasonably modest-cost stove and heat-exchanger which will conveniently generate wood-fueled hot water year-round to meet household needs and daily demand schedules. Included with this report are the illustrations, descriptions, and details which should make it possible for someone with the proper skills to construct their own system. However, before rushing out to buy copper and steel, it would be important for anyone to consider the costs, benefits, and possible alternatives available. Whatever the source of hot water, conservation is a major way of saving energy and money. Some major ways of conserving are to add extra insulation to the water heater tank, turning the heating elements down to 115 to 120°F thermostat settings, using a timer to turn on the elements only during the time of day that hot water will be needed, using warm or cold water for laundry, and using flow-restricting shower heads. These measures can save up to 50% of the energy previously used, with very little investment. Total costs for the system using an existing water heater for the storage tank could range from $200 to over $1000. Assuming free firewood, at current utility prices this would make a payback period for original investment of only 8 months to 3 years 4 months for the average family. Considering these costs, one might reasonably wonder if it would be worthwhile to purchase and use a wood-fired system which would save only a dollar or less per daily use. This would amount to a rate of savings pay equal to no more than the minimum wage for the time involved.

22787 **(DOE/R3/06092—T1) Waste water recycling: toilet application. Final report.** Soneson, S.; Soneson, J. (Soneson (Sigfried), Bryn Athyn, PA (USA); Soneson (Judith), Bryn Athyn, PA (USA)). 22 Sep 1980. Contract FG43-79R306092. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009192.

Our conclusion is that for our small family of four, this recycling system is a success. As seen on pages 7 and 10, the system does save water, and, our biggest goal, our cesspool does no longer overflow. We are admittedly light users of water due to our habits over the years to save cesspool overflow. But it seems that heavy users would be heavy in all areas and that it would still even out. The only change for a larger family might be the use of a larger collection tank to handle the larger volume of water. Another recommendation would be to not connect the bathroom sink to the system. We are perfectly happy to have it the way it is, but it might be nice to have a recepticle in the bathroom for substances that shouldn't be recycled. And, in our case at least, the water accumulated by the sink did not help that much. We have already had a number of inquiries about our system and we think that in the future, with a dwindling water supply, that there will be even more interest. It just plain makes good sense not to flush with fresh clean water.

22788 **(DOE/R3/06107—T1) Waste water heat recovery and water source heat pump. Final report.** Demster, S.J. (Demster (Stanley J.), Midlothian, VA (USA)). 1 Sep 1981. Contract FG43-79R306107. 31p. NTIS MF A01; 2; GPO Dep. File Number DE85009248.

This project involved the retrofitting of a two-year-old home in Midlothian, Virginia, with a synergistic heating/cooling system that featured waste water and ground water as an efficient energy source/sink. Because the local community enforces very strict architectural control and local tree growth prohibits the use of solar technology, this approach was selected. This concept caused no visible alterations in the structure and it was possible to greatly extend the savings already resulting from an efficient envelope design. The project incorporated energy management, energy storage and a more efficient thermal cycle. A water-to-air heat pump cycle was substituted for an air-to-air heat pump cycle. The major factor was anticipated to be the recovery of heat from waste water and ground water. Previous analysis indicated the major energy consumption was associated with the heating of occupied space. The waste water was a relatively high temperature source of heat. This project has far-reaching implications because it was not a concept which was dependent on geographic location, architectural style or new construction. This concept is applicable to the majority of single-family American homes. The project demonstrated the systems as designed would function as predicted. However, many components failed due to various construction defects, most of which was the result of the project's low budget approach. As system problems developed, corrective measures were instituted or planned.

22789 **(DOE/R3/06109—T1) Underground Manufacturing Facility, Sterling, Virginia. Final report.** Barlow, R.M. (Barlow (Robert M.), Great Falls, VA (USA)). 25 Sep 1981. Contract FG43-78R306109. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009154.

The author set out to build an earth-sheltered light manufacturing plant (to produce expanded polystyrene insulation) and also an earth-sheltered passive solar residence. Results are presented of waterproofing, thermal monitoring, and life cycle study on the plant. It is concluded that the added cost of providing a support for carrying the earth deadload far outweighs the energy savings. (DLC)

22790 **(DOE/R3/08074—T1) HOWSE (HOt Water SAver) test program. Final report.** Olson, W.R. (Olson (Wayne R.), Catonsville, MD (USA)). 15 Jun 1983. Contract FG43-81R308074. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009189.

The feasibility of recovering heat from a domestic dishwasher was demonstrated in a working, full scale model. That project showed it could be done. This test program showed the HOWSE to be effective and safe over a period of eighteen months. The data from the test program is essential to show safety for requesting approval for use of this appliance by building code authorities.

22791 **(DOE/R3/08099—T1) Research on the energy efficiency of fireplaces. Final report.** Phillips, W.H. (Virginia Associated Research Campus, Newport News (USA)). Oct 1982. Contract FG43-81R308099. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009382.

Studies are presented of factors involved in improving the energy efficiency of fireplaces. A computer program is presented to represent the operation of a fireplace with a heat exchanger. The effects of fine-mesh screen wire for the fireplace screen and the effects of heat-exchanger design parameters are investigated. 12 references, 14 figures.

22792 **(DOE/RL/01830—16) Residential and commercial buildings data book.** (Pacific Northwest Labs., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 237p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85008486.

A current and reliable source of information on building characteristics and energy consumption patterns is a fundamental requirement for effective R and D and program planning in the Office of Building Energy Research and Development (BERD). This document is intended to complement other BERD information sources by compiling the most current data on the stock characteristics of residential and commercial buildings, building stock energy consumption, historical trends, and forecasts. The information contained herein was assembled to make data from diverse sources more readily available to BERD project managers and staff. The data will assist the BERD staff perform two vital functions: determine areas in which research to improve energy productivity might provide significant energy savings; and estimate the actual effect that specific research projects may have on energy productivity and conservation in the buildings sector. These functions are important because the BERD program is responsible for establishing the general direction of a major, long-term research program and for

initiating specific research projects that will eventually fulfill the program goals. Current plans call for this document to be updated and revised from time to time as new and better data become available. Accordingly, users of this data book are encouraged to submit requests, information, or comments to the Pacific Northwest Laboratory to enhance the usefulness of future editions. This report is divided into three main sections: Overview of Selected Energy Variables; Residential Buildings; and Commercial Buildings. The Overview contains historical total US energy consumption by major sector; historical and projected fuel prices; and forecasts of residential and commercial sector activity.

22793 **(EEC—156) Technion swimming pool: comparison of measurements with the results of a computer simulation and calculation of the effects of conservation measures on the heating load.** Michelson, E.; Shitzer, A. (Technion-Israel Inst. of Tech., Haifa. Dept. of Mechanical Engineering). Nov 1984. 81p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85900453.

Measurments on the Technion indoor swimming pool taken in November 1981 are compared with the results of a computer simulation. Equations for calculating the heating loads of the pool hall, pool water and shower are presented. The measurement system used to monitor the energy subsystems in the pool is described. Validation of the computer model is included along with a brief discussion of the effects of conservation measures on the heating load. Economic considerations of solar heating retrofit are provided. A listing of the computer program is also included. (BCS)

22794 **(FRNC-TH—1722) Room thermal transfer function and its application to the optimization of energy consumption in air conditioning systems.** Dumez, M. (Paris-6 Univ., 75 (France)). Jan 1982. 186p. (In French). NTIS (US Sales Only), PC A09. File Number DE85751006.

Methods for studying the non-stationary regime applied to a wall are first presented. The thermal behaviour of a premises in the transient regime is then studied. The contribution from the period of sunshine on the windows is calculated. One deals after, with the spontaneous behaviour of an unheated premises. Finally, optimization problems are discussed.

22795 **(LBL—16073) Electrochromic materials and devices for energy-efficient windows.** Lampert, C.M. (Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098. 52p. (EEB-W—84-08). NTIS, PC A04/MF A01; GPO Dep. File Number DE85008585.

Numerous inorganic and organic electrochromic materials are discussed in the context of developing a film-based optical shutter for a window application. It is possible electronically to alter a window's transmission and reflection properties by use of electrochromic thin films. This allows regulation of conductive and radiative heat transfer rates, with variable optical attenuation. As a result, an aperture can be optically and thermally managed, reducing space heating and cooling loads. The properties of transition metal oxides, such as WO_3, MoO_3, In_2O_3 and V_2O_5, are detailed. Organic systems, such as heptyl viologen and polytungsten anion, are reviewed. Also, intercalated structures are discussed. Various designs of working devices are outlined with emphasis on solid-state configurations. From this quantification, materials and devices with appropriate deposition techniques for window applications are detailed. 161 references, 9 figures, 4 tables.

22796 **(LBL—17457) Energy performance and savings potentials with skylights.** Arasteh, D.; Johnson, R.; Selkowitz, S.; Sullivan, R. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 29p. (CONF-850123—2; EEB-W—85-01). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009933.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Chicago, IL, USA (27 Jan 1985).

This study systematically explores the energy effects of skylight systems in a prototypical office building module and examines the savings from daylighting. For specific climates, roof/skylight characteristics are identified that minimize total energy or peak electrical demand. Simplified techniques for energy performance calculation are also presented based on a multiple regression analysis of our data base so that one may easily evaluate daylighting's effects on total and component energy loads and electrical peaks. This provides additional insights into the influence of skylight parameters on energy consumption and electrical peaks. We use the DOE-2.1B energy analysis program with newly incorporated daylighting algorithms to determine hourly, monthly, and annual impacts of daylighting strategies on electrical lighting consumption, cooling, heating, fan power, peak electrical demands, and total energy use. A data base of more than 2000 parametric simulations for 14 US climates has been generated. Parameters varied include skylight-to-roof ratio, shading coefficient, visible transmittance, skylight well light loss, electric lighting power density, roof heat transfer coefficient, and electric lighting control type. 14 references, 13 figures, 4 tables.

22797 **(NP—5900586) High temperature working fluids and nonazeotropic mixtures in compressor driven heat pumps.** Berntsson, T.; Ljungkvist, K.; Moser, F.; Schnitzer, H. (Chalmers Univ. of Tech., Goeteborg (Sweden); Technische Univ., Graz (Austria)). [1985]. 305p. NTIS (US Sales Only), PC A14/MF A01. File Number DE85900586.

Several firms around the world offer the data necessary for engineering calculations. The data are organized in so-called data banks. The data banks can often be used either as pure data sources or as subroutine packages used in connection with a simulation or design program. Important pure component properties of hydrocarbon and other substances are stored either as point values or fitted to equations in order to cover a wide temperature and pressure range. Five commercially available data banks are briefly presented: PPDS, KEYDATA, DETHERM, EPIC, and TISDATA. Many more data banks exist in the world, but the five mentioned above are chosen as examples to illustrate what data banks can offer. Data banks also exist at technical universities. The university data banks are normally not open to the public, but used in research and education. They will not be considered in this work. Some engineering firms also support their own data banks. Their banks are not open for others to use and are not discussed here. The most important facts about the five data banks mentioned are presented. Some comments on each data bank are given. 359 references.

22798 **(ORNL/SUB—82-22293/2) Roofing industry perspective and research capability.** Busching, H.W.; Porcher, J.P. Jr. (Clemson Univ., SC (USA). Dept. of Civil Engineering). Mar 1985. Contract AC05-84OR21400. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009988.

This report provides a qualitative and numeric summary of the US roofing industry with emphasis on its infrastructure and research profile. Descriptive models of the following activities are presented: roof design, pre-construction activities, roof construction and acceptance, roof maintenance, resolution of roof complaints, and dissemination of roofing information. Principal groups that deal with roof industry issues are identified together with categories of generic roof research. A brief discussion of the results of a survey of industry-sponsored roofing research is presented. A review of research equipment and approximate research budgets is given. Needed roofing research is identified from discussions with industry and public sector representatives and from reviews of selected reports. References are included together with a listing in the Appendix of roofing manufacturers and products.

22799 **(PB—85-135846/XAB) Weatherize project.** Moffatt, S. (Ontario Ministry of Municipal Affairs and Housing, Toronto (Canada)). Feb 1984. 109p. NTIS, PC E06/MF E01.

A two year research and demonstration project was undertaken by the Ontario Ministry of Municipal Affairs and Housing to demonstrate new techniques, transfer new technology and research critical issues concerning the impact of air tightening on typical houses.

22800 **(PB—85-140879/XAB) Ventilation efficiency. Part 4. Displacement ventilation in small rooms.** Mathisen, H.M.; Skaret, E. (SINTEF, Trondheim (Norway)). 23 May 1983. 192p. (STF—15-A84047). NTIS, PC E05/MF E05.

See also PB85-140887. Sponsored by Royal Norwegian Council for Scientific and Industrial Research, Kjeller.

The objective of this research project is to study the effect of low air velocity supply direct to the zone of occupation in small rooms with regard to effective ventilation and thermal comfort. A two-zone mixing model is used to describe the concept of, and to define the effectiveness of ventilation.

22801 **(PB—85-140887/XAB) Ventilation efficiency. Part 6. A survey of concepts of ventilation effectiveness.** Skaret, E. (SINTEF, Trondheim (Norway)). 18 Jul 1984. 48p. (STF—15-A84057). NTIS, PC E04/MF E04.

See also PB85-140879. Sponsored by Royal Norwegian Council for Scientific and Industrial Research, Kjeller.

This report contains a summary of state of the art regarding concepts of ventilation effectiveness (efficiency) and are dealing with one-zone models, two-zone models and the concepts derived from age distribution analyses. Ventilation effectiveness can principally be separated in two parts: (i) the air-exchange efficiency for the ventilation air flow, and (ii) the ventilation effectiveness or the removal effectiveness of contaminants. Both are overall values for the total room volume. In addition it is shown how local conditions can be assessed. The last part of the report reviews results from a test chamber where described concepts are used.

22802 **(PNL—5027) Commercial building end-use energy metering inventory.** Heidell, J.A.; Mazzucchi, R.P.; Reilly, R.W. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009946.

Pacific Northwest Laboratory conducted a comprehensive inventory of end-use metered data. The inventory did not discover many sources of metered end-use data; however, research into existing data bases and extensive discussions with professionals associated with building energy conservation have enabled a clear characterization to be developed of the types of metered data that are required to further energy conservation in commercial buildings. Based on the results of the inventory and this clarification of data requirements, the adequacy of existing data bases has been assessed, and recommendations have been developed for future federal data collection efforts. A summary of sources of existing metered end-use data is provided in Section 2.1 and its adequacy has been summarized. Collection of further end-use metered data is both desirable and valuable for many areas of building energy conservation research. Empirical data are needed to address many issues which to date have been addressed using only simulation techniques. The adequacy of using simulation techniques for various purposes needs to be assessed through comparison with measured data. While these data are expensive to acquire, it is cost-effective to do so in the long run, and the need is not being served by the private market. The preceding conclusion based on results from the inventory of existing data highlights two important facts: First, although the data are widely desired in the private sector, they are not widely available. Second, where suitable data are publicly available and contain the desired supporting information, their collection has generally been funded by government-sponsored research.

3202 Transportation

REFER ALSO TO CITATION(S) 32020023072

22803 **(AD-P—004277/0/XAB) Effect of hitch positions on the performance of track/grouser systems.** Yong, R.N.; Elmamlouk, H.; Skiadas, N. (McGill Univ., Montreal, Quebec (Canada). Geotechnical Research Centre). Aug 1984. 17p. NTIS, PC A02/MF A01.

This article is from Proceedings of the International Conference on the Performance of Off-Road Vehicles and Machines (8th), Volume 1, held at Cambridge, England on August 5-11, 1984, AD-A148 635, p 381-397.

A number of previous research studies have been performed with the objective of developing a model to predict the performance and efficiency of tracks on ground terrain. For proper modelling, several approaches documented in the literature have been used on: (1) Strip footing idealization of the track contact area with elastic stress distribution in the soil; (2) Energy dissipation within the failed soil mass; and (3) Energy conservation considerations for the track/grouser-soil system.

22804 **(N—85-10908) ACEE program rationale and implementation.** Aiken, W.S. Jr.; Petersen, R.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Aug 1982. 34p. (NASA-TM—84549). NTIS, PC A03/MF A01.

The impact of the Aircraft Energy Efficiency program (ACEE) on commercial aviation is examined. In addition to the emphasis on air transport fuel efficiency, topics such as airline operating costs, air transport effects on U.S. trade, and fuel price forecasts are addressed. An overview of the program and its contribution to aviation technology is included.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 32030022386, 22389, 22406, 22500, 22507, 22589, 22907

22805 **(AD-A—147885/8/XAB) Heat-Recovery-Incinerator equipment selection and plant layout for safety, human engineering, and maintainability. Final report, February-October 1983.** (VSE Corp., Camarillo, CA (USA)). Oct 1984. 43p. NTIS, PC A03/MF A01.

The Naval Civil Engineering Lab. Solid Waste Advanced Development Project includes formulation of design requirements and guidance for small-scale Heat-Recovery-Incinerators (HRI) to be constructed at various naval shore activities. HRI technology for conversion of the heat value of solid waste to usable energy through production of industrial and domestic steam is applicable to a number of Navy and Marine Corps activities. Most of these activities require facilities with a capacity in the range of 50 tons per day, the designs of which would use predesigned, prefabricated modular units. While a number of this type of facility has been constructed in the private sector, and a few in the Navy, plants with maintainability problems and less than optimum safety features are common. This task was to develop generic equipment choices, instrumentation requirements and locations, and general plant layouts giving equipment arrangements and spacing. Emphasis was given to safety and human engineering considerations. Plus equipment maintenance requirements. Specific recommendations on design features and a basic equipment layout are given.

22806 **(AD-P—004225/9/XAB) New developments in materials recycling.** Horton, R.C.; Kenahan, C.B. (Bureau of Mines, Washington, DC (USA)). Apr 1984. 24p. NTIS, PC A02/MF A01.

This article is from the Proceedings of the Meeting of the Structures and Materials Panel (57th) held at Vimeiro, Portugal on 14-19 October 83, AD-A148 598, p 15.1-15.24.

This paper presents promising technical solutions to complex recycling problems such as recovery of cobalt, nickel, and chromium from superalloy scrap; the separation, recovery, and reuse of nickel and chromium from stainless and specialty steel wastes; precious metal recovery from electronic scrap; an environmentally acceptable method for recycling lead-acid batteries; recovery of nonferrous metals from scrap automobiles; and rapid scrap identification methods suitable for today's modern alloys.

22807 **(DOE/R3/02444—T1) Utilization of low grade coal. Final report.** Wells, C.E. (Wells (Clifford E.), Buchanan, VA (USA)). 1 Dec 1981. Contract FG43-80R302444. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008983.

Purpose was to construct and use a pilot furnace that could utilize low-grade coal (steam coal and coal fines) in place of oil or natural gas. This pilot furnace was tested on a 66-inch Raymond H.S. Roller Mill at the No. 1 plant of the James River Limestone Co. Results indicate that the commercial use is feasible; drying costs average $0.36 per ton with coal vs $0.80 per ton on annual basis when oil fired. Results are applicable to limestone manufacturers producing dry pulverized products. (DLC)

22808 **(DOE/R3/06098—T1) Economic and technical feasibility of utilizing fish waste as organic nutrients for farm/horticultural use. Final report.** Gargasz, R.E.; Pye, E.K. (Altergy, Inc., Volant, PA (USA)). [1985]. Contract FG43-79R306098. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009190.

Results of a study to determine the technical and economic viability of utilizing fish wastes and other organic residues as organic peat nutrients for agriculture/horticulture applications are presented. The project tasks included: (1) Reputable analysis of the waste products to determine the primary plant nutrients, nitrogen, phosphorus, and potash as well as trace elements; (2) Technical feasibility of reducing these organic wastes into nutrients, valuable and assimilable by agricultural or horticultural crops or as a high protein animal feed; and (3) The economic viability of commercializing, manufacturing, and marketing these waste products as a specialty plant growth substance/high protein feed supplement.

22809 **(DOE/R3/06102—T1) Heat pipe application to farrowing house. Final technical report.** Clay, J.S. (Virginia Settlers Energy Center, Blacksburg (USA)). [1985]. Contract FG43-79R306102. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009220.

The heat exchanger system was monitored for approximately three weeks at the end of the heating season. It is the conclusion of the author that insufficient data was collected to make an estimate of system efficiency or fuel savings. It is still believed that the heat pipe application to the farrowing house is a viable alternative to fossil fuel use. The system is now being monitored and will continue to be monitored throughout the 1980-1981 heating season. The data collected during this monitoring will be examined in the spring of 1981 and the results will be sent to the United States Department of Energy Region III office in Philadelphia. This is a valuable project and it would not have been possible without the financial support of the federal government. It is the author's sincere desire to cooperate fully with the Department of Energy in the future testing of this system.

22810 **(DOE/R3/08075—T1) Compost-powered food drying project. Final report.** (New Day Vegetarian Foods, Inc., Chestertown, MD (USA)). [1983]. Contract FG43-81R308075. 19p. NTIS MF A01; 2; GPO Dep. File Number DE85009163.

Results of a study performed to demonstrate the use of heat generated from compost piles to dry food are presented. Results indicate that compost pile heat, the main source of heat for the dryer, performed rather erratically in past trials, but its positive effects on the environment merit more study. The increase in nitrogen fertilizer value of finished compost over the original materials ranged between 25% and 90%. This replaces nitrogen usually made with fossil fuels, without generating any known toxic effects on the surrounding environment. Bacteria are very efficient workers that can be harnessed to do certain tasks. Heating and producing nitrogen would be using the same bacteria to do two jobs efficiently. When too much heat is extracted from a pile, the bacteria cannot function efficiently and the pile cools down. Therefore there is only a limited amount of heat available for outside uses. This amount of heat is felt to be proportionate to pile size, so a larger pile could meet the heating demands of the dryer used in the project. Operator expertise is very critical in composting for heat and is effectively gained only through experience. Since the cost effectiveness of the operation depends on using waste materials available at the site, the operator must find the correct combination of these materials and combine them correctly. The length of time involved in fully composting materials and the seasonal limitations of the method combine to bring expertise to the operator only after years of composting. A positive side effect of the project has been the realization of the usefulness of the pre-made insulated box (used refrigerator truck body) in temperature controlled situations. It has proved to be a very cost effective and portable dryer.

22811 **(DOE/R3/08077—T1) [Thermal energy audits. Final reports for canning companies].** Frey, B.C.; Schlimme, D.V. (Maryland Univ., College Park (USA). Dept. of Agricultural Engineering). 30 Sep 1983. Contract FG43-81R308077. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009389.

The Thermal Energy Audit Final Reports for eleven canning establishments are presented. All but one of the companies are located in Maryland. The eleven companies pack virtually the complete spectrum of vegetables processed in Maryland and surrounding states; they ranged in size from small establishments canning a single product during an eight to 10 week season to moderate sized operations processing eight to nine months per year. This study included four principal areas of investigation, viz., boiler operations, boiler water conditions including pH, alkalinity, hardness and iron level, steam leaks in the steam distribution system and insulation of the steam distribution system and thermal processing equipment. Emphasis was on product processing rather than space heating. Purpose was to develop a relatively simple method to evaluate and subsequently correct several common types of thermal energy inefficiencies. The corrections should be easily and inexpensively implemented by in-house personnel, i.e., changes which provide significant energy (cost) savings with only modest expenditures providing short-term (1 to 2 year) payback. A modest goal of reducing fuel consumption by 9% at each of the eleven companies was established. The estimated average reduction in fuel consumption achieved was 5.9%: 0.6% due to boiler improvement, 1.0% due to correcting steam leaks, and 4.3% due to insulating piping and equipment.

22812 **(EGG-M—06285) Industrial heat pumps: types and costs.** Chappell, R.N.; Bliem, C.J. Jr.; Mills, J.I.; Demuth, O.J.; Plaster, D.S. (Idaho National Engineering Lab., Idaho Falls (USA); Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). Mar 1985. Contract AC07-76ID01570. 10p. (CONF-850301—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008936.

From 12. annual energy technology conference and exposition; Washington, DC, USA (25 Mar 1985).

Many potentially beneficial applications for industrial heat pumps are not being pursued because of confusion regarding both energy savings and economics. Part of this confusion stems from the variety of heat pumps available and the fact that the measure of merit, the coefficient of performance (COP), is commonly defined in at least three different ways. In an attempt to circumvent this problem, a simple categorization was developed based on the commonly accepted COP definitions. Using this categorization, the cost of recovering waste energy with heat pumps was examined. Examples were evaluated in which the cost of energy delivered was calculated based on estimates of capital cost, operating costs, and maintenance costs. Heat pumps from the various categories were then compared on the basis of economics.

22813 **(NP—4901622) Energy conservation in ceramic giftware using Canadian minerals and raw materials. Final report.** Miller, R.L.; Kapadia, M. (Blue Mountain Pottery Ltd., Collingwood, Ontario (Canada)). 20 Sep 1983. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84901622.

The first phase of a program initiated to develop single fired decorative ceramic giftware has been completed. The project was undertaken by Blue Mountain Pottery Limited to identify suitable ceramic body formulations with low firing temperatures in the firing range of decorative ceramic decals (750 to 850°C). Body compositions based on local clay raw materials, with minor additions of either glass cullet or a commercial glass frit, have been identified which successfully fulfilled the project objective. A similar clay-based formulation containing zinc oxide and titanium dioxide was also identified which produced a much lighter colored body than the conventional Blue Mountain body. It is anticipated that these bodies could form the basis of a new Terra Cotta product line which is foreseen to have a substantial export market in both Japan and the United States. Four of the most promising candidate body formulations are tabulated.

22814 **(PB—85-144293/XAB) UK (United Kingdom) industrial energy demand: economic and technical change in the steam boiler stock. Occasional paper series.** Chesshire, J.; Robson, M. (Sussex Univ., Brighton (UK). Science Policy Research Unit). [1984]. 120p. NTIS, PC E06/MF E06.

This report is based on a four-year study, including a survey of a sample of 30,000 out of the estimated total of 73,000 steam

boilers currently installed in UK industry and commerce. The main aim of the report is to identify likely future changes in the level and pattern of boiler fuel use which will be largely determined by the characteristics of the current capital stock of boilers. In particular, it focuses on the interaction between capital costs, fuel prices, and load factors, and the distribution of output capacities, design types, and the age profile of the boiler stock.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 32060022805

22815 **(ANL/CNSV-TM—154) Evaluating options for community energy plans: a community comparison.** Tschanz, J.F. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 87p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009783.

This report has summarized and compared the methods applied by the communities that made a formal assessment of energy management options during Phase II of the Comprehensive Community Energy Management Program (CCEMP) case studies. The Phase II assessments provided consistent information on option effects, which enabled more objective rankings of options to be made than was generally possible in Phase I. All of the communities started the assessment process with a comprehensive listing of options, which in some cases entailed additions to the options listed in Phase I. The assessment methods have been reported for the major categories of option effects: energy conservation, direct economic costs and benefits, employment and other indirect economic effects, environmental effects, and impacts on energy utilities. The numerical results of the assessments have not been comprehensively tabulated and analyzed here, because: (1) the options and variables chosen were not always consistent among the communities; and (2) the size of the sample for any particular option was generally too small, given different conditions in the various communities, to establish any quantitatively significant conclusions. The final conclusion is not about methods, but about the process for carrying out the assessments and, especially, the role of public participation in that process. Several of the projects showed that an options assessment process, in which individual effects categories were examined in separate steps, could be carried out in a way that would involve the continuing participation of committees with advisory and oversight responsibilities. When there is such participation, the process may naturally lead to consensus on the relative priority of options and on the steps needed to implement the highly ranked options. 37 references, 5 figures, 19 tables.

22816 **(DOE/R3/06044—T1) Direct recycling of municipal ferrous wastes for local foundry application. Final technical report.** (Technical Information Project, Inc., Washington, DC (USA)). 9 Jan 1981. Contract FG43-79R306044. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009249.

This project investigated the concept of direct recycling as an appropriate technology (AT) approach to improving resource recovery from wastes in Region III. Direct recycling is the process of bringing waste materials directly to reprocessing facilities with few or no intermediate processing steps. Municipal Ferrous Waste (MFW) was the waste material involved. The Region III states were surveyed for (a) municipal recycling systems incorporating MFW separation and (b) grey iron foundries where MFW could be utilized. Contacts and visits were made with foundry and recycling group personnel. A handbook titled Tin Cans and Trash Recovery was prepared for distribution to interested persons in Region III. This handbook delineates the direct recycling method for MFW, describes recycling potential for areas of different populations in the Region, and lists foundries, recycling groups, and resource persons for the Region. It was distributed widely in Region III and elsewhere.

22817 **(DOE/R3/06089—T1) Rural Recycling Center for tin, glass, aluminum, and newspaper.** (Pleasant Mount, Community of, PA (USA)). 1980. Contract FG43-79R306089. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009303.

Data on the outcome of the project are presented. Recycling was available to the residents of Pleasant Mount and Forest City, Pennsylvania on alternate Saturdays at the beginning of the project in February 1980. In April, the schedule was altered; the recycling centers in each community were open only 1 Saturday per month. A baler, a fork lift and safety equipment were purchased. (DMC)

3209 Education And Public Relations

22818 **(DOE/IR/10984—1) Second annual practitioners conference on energy education: proceedings.** Hofman, H.H.; Miller, F.G. (eds.). (National Science Teachers Association, Washington, DC (USA)). 1979. Contract AC05-80IR10984. 92p. (CONF-791298—). NTIS, PC A05/MF A01; GPO Dep. File Number DE85008625.

From 2. annual practitioners conference on energy education; Rockford, IL, USA (9 Dec 1979).

This conference was held in Rockford, Illinois, on December 9-11, 1979. This report is divided into: conference overview, education: the path to a new energy ethic, accomplishments and the needs of energy, and working group reports. (DLC)

22819 **(DOE/R3/06264—T1) Alcohol-Methane Project. Final report.** Ricks, N.L. (Wilson Coll., Chambersburg, PA (USA)). 30 Jun 1983. Contract FG43-80R306264. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010168.

Progress accomplished during the period July 1, 1980 to September 30, 1983 is summarized. The purpose of the project was to conduct adult education workshops in alcohol and methane production and cellulose conversion. The attempt to continue the alcohol-methane project at Wilson College via adult education was not successful. A Cellulose Conversion Workshop was attended by fourteen people in November, 1983 despite a large mailing. A number of difficulties were encountered. These have been presented in detail above with the view of documenting in a specific way problems which reflect larger issues beyond the scope of this particular project and which have implications for the field at large. In general, the results of this project suggest: (1) A lack of current interest within the general population in alternative fuels. This is probably related to lower fuel prices. (2) Strong interest in this subject by a few but in numbers not sufficient to support major projects and expenditure of funds. (3) An unusual pattern of expertise in this area. Individuals with the strongest background in alternative fuels tend to be drawn from non-academic circles while the academicians lack experience in practical applications. This accounts for the problems encountered in finding suitable instructors and the difficulty with the teaching tools and quality of instruction. Those who have the expertise have difficulty in conveying it; those who can teach do not have the practical experience. Adult education efforts might better be directed at assisting those with the practical experience in learning how to convey this information to others.

22820 **(DOE/R3/08086—T1) Application of energy savings in an urban setting. Final report.** Greenberg, H. (Grass Roots Alliance for a Solar Pennsylvania, Philadelphia (USA)). 15 Mar 1982. Contract FG43-81R308086. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009513.

The South Philadelphia Energy Education Program was run as a part of GRASP's ongoing Community Energy Education Program (CEEP). CEEP helps neighborhood groups to build local resources to meet local energy needs through educational workshops, energy training sessions, and the establishment of cooperative energy programs. The South Philadelphia program was conducted in a largely new geographic area where support for GRASP programs had not been previously generated. Thus while the program was not markedly successful in terms of numbers of residents reached with energy information, the program did lend itself well to establishing the basis for future programs in this geographic area. With 13 community residents trained as neighborhood energy auditors, a good base has been established for community groups to run their own programs. GRASP will continue to work with interested groups in this area.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

22821 (DOE/ET/12439—T1) Velocity characteristics of the flow in motored engines. Final report. Gosman, A.D.; Whitelaw, J.H. (Imperial Coll. of Science and Technology, London (UK). Dept. of Mechanical Engineering). Jan 1980. Contract FG03-78ET12439. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008733.

The influence of piston-head geometry, compression and rotational speed has been investigated. Measurements and calculations, without compression have shown the influence of a cylindrical bowl to be negligible; it is expected, and work is in progress to obtain direct evidence, that the influence will be significant with compression. Measurements in a Petter engine have, however, shown that compression has little influence at bottom dead center on the expansion stroke and that a substantial region of solid-body rotation exists in both cases. The influence of rotational speed on the flow patterns and turbulence intensity have been shown to be small except in the immediate vicinity of the inlet port and for rotational speeds (<100 rpm) when the flow is not turbulent. 25 references, 11 figures.

22822 (N—85-10947) Energy Efficient Engine flight propulsion system preliminary analysis and design report. Bisset, J.W.; Howe, D.C. (United Technologies Corp., East Hartford, CT (USA)). Sep 1983. 166p. (NASA-CR—174701). NTIS, PC A08/MF A01.

The final design and analysis of the flight propulsion system is presented. This system is the conceptual study engine defined to meet the performance, economic and environmental goals established for the Energy Efficient Engine Program. The design effort included a final definition of the engine, major components, internal subsystems, and nacelle. Various analytical representations and results from component technology programs are used to verify aerodynamic and structural design concepts and to predict performance. Specific design goals and specifications, reflecting future commercial aircraft propulsion system requirements for the mid-1980's, are detailed by NASA and used as guidelines during engine definition. Information is also included which details salient results from a separate study to define a turbofan propulsion system, known as the maximum efficiency engine, which reoptimized the advanced fuel saving technologies for improved fuel economy and direct operating costs relative to the flight propulsion system.

22823 (PB—85-124154/XAB) Characterization of heavy-duty motor-vehicle emissions under transient driving conditions. Warner-Selph, M.A.; Dietzmann, H.E. (Southwest Research Inst., San Antonio, TX (USA)). Nov 1984. 166p. NTIS, PC A08/MF A01.

The objective of this program was to characterize heavy-duty diesel truck and bus emissions produced during transient driving cycles. In the initial phase of the program an improved road-load simulation method was developed for use in operating large trucks on a chassis dynamometer. This method was used in testing vehicles on the chassis dynamometer. The second phase of testing involved operation of six vehicles on the chassis dynamometer removal of the engine and testing of the engines. Chassis emissions were then compared to engine emissions. Additionally, chassis tests were conducted over a range of dynamometer inertia settings for two of the six vehicles for the purpose of comparison with engine emissions. Baseline emissions were also measured on six buses, five single-axle tractors, and 17 dual-axle tractors over the chassis version of the transient cycle. Regulated emissions and several unregulated emissions were measured on baseline tests. Unregulated emissions included particulate, aldehydes and ketones, phenols, DOAS odor, various elements, nitropyrenes, and Ames mutagenic response.

22824 (PB—85-126126/XAB) Characterization of emissions from advanced automotive power plant concepts. Montalvo, D.A.; Hare, C.T. (Southwest Research Inst., San Antonio, TX (USA)). Nov 1984. 485p. NTIS, PC A21/MF A01.

Emissions from three diesel cars using two fuel formulations were assessed. The three diesel cars included a prototype naturally-aspirated Fiat 131, a prototype turbocharged Fiat 131, and a 1981 Oldsmobile Cutlass Supreme. Each Fiat was tested with and without a prototype catalytic trap. Vehicle operating procedures used for test purposes included the 1981 Federal Test Procedures as well as the Highway Fuel Economy Test, the New York City Cycle, and an 85 km/hr steady-state cruise. Both regulated and unregulated gaseous and particulate emissions were measured. Organic solubles in particulate were analyzed for various constituents and characteristics including fractionation by relative polarity, benzo(a)pyrene (BaP), and mutagenic activity by Ames bioassay. Application of the catalytic trap oxidizer system to the Fiat prototypes resulted in significant reductions of organic and carbon monoxide emissions under all transient driving conditions examined. Total particulate emissions were reduced an average of 55 percent with the turbocharged engine and 65 percent with the naturally-aspirated engine. The Ames assay mutagenic response (revertants/microgram) of the particulate-phase organics was elevated by the catalytic exhaust aftertreatment device, however the emission rates (revertants/km) were reduced an average of 66 percent with the turbocharged and 73 percent with the naturally-aspirated engines.

22825 The status of US R&D in use of alternative transportation fuels. Fleming, R.D.; Ecklund, E.E. (U.S. Dept. of Energy, Washington, DC). pp 287-293 of Nonpetroleum Vehicular Fuels IV. Chicago, IL; Institute of Gas Technology (1984). (CONF-840470—).

From Nonpetroleum vehicular fuels IV symposium; Arlington, VA, USA (16 Apr 1984).

During the ten years of Federal sponsorship of energy R&D which followed the 1973-74 oil supply upset, considerable progress has been made in establishing the technical data base for utilization of alternatives to petroleum products in transportation applications. Taking into account competitive economics and the potential timing of marketability of substitutes and alternatives, a reasonable technical information base now exists for use of alcohol fuels (neat and blends), methane and hydrogen in spark ignition engines. Barriers to commercialization of these fuels have also been identified and delineated. Some initial testing of synthetic fuels (synfuels) has been conducted, primarily on fuels formulated with light fractions of coal-derived liquids which emulate petroleum products. Current efforts focus on assuring availability of synfuels made to custom specifications for test purposes, and to then use selected compositions to identify and better understand problems associated with use of fuels with changed specifications especially those of heavier composition. Also investigation is on-going to seek improved methods of quantifying ignition quality of distillates applicable to both petroleum products from heavier crudes and to synfuels. A comprehensive screening evaluation of hybrid fuels made from petroleum products mixed with energetic shelf items have verified that there is little, if any opportunity for use of unique fuels. Some selected work is on-going and may continue to fill data gaps in the use of methane and alcohol fuels, with some of this involving the potential for use in compression ignition engines.

3303 Electric-powered Systems

22826 (DOE/CS/54209—25) Improved battery state-of-charge indicator. Final supplemental report. (Gould, Inc., Rolling Meadows, IL (USA). Electronic and Computer Systems Lab.). 30 Sep 1984. Contract AI01-78CS54209. 151p. (JPL—9950-970). NTIS, PC A08; 3; GPO Dep. File Number DE85006661.

The improved SCI system developed during Modification No. 5 of this contract successfully fulfilled the target performance goals. The improved battery parameter adaptor will track the aging of the battery with a high degree of confidence. The values installed in the starting battery parameter array do have to be qualified to insure SOC accuracy. Furthermore, the battery charger and

SCI interface handshaking communications must be maintained to allow proper operation of the SCI. Some recommendations are suggested for future high performance eV state-of-charge indicators.

22827 (EGG-SE—6752) Electric and Hybrid Vehicle Program, FY-1985 program plan. Hunt, G.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1985. Contract AC07-76ID01570. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008933.

This program plan serves as the primary management document for the INEL Electric and Hybrid Vehicle (EHV) Program. Programmatic objectives are set forth, the scope of the work is defined, and the management methodologies used to perform and control the work are presented. Programmatic interfaces and attendant responsibilities are defined. A technical plan describing the engineering tests, development work and technical support activities which constitute the core of the program is provided.

3306 Vehicle Design Factors

22828 (N—85-10993) Energy Efficient Engine ICLS Nacelle detail design report. Eskridge, R.R.; Kuchar, A.P.; Stotler, C.L. (General Electric Co., Cincinnati, OH (USA)). Jul 1982. 125p. (NASA-CR—167870). NTIS, PC A06/MF A01.

The results of the detail design of the Nacelle for the General Electric Energy Efficient Engine (E3) Integrated Core Low Spool (ICLS) test vehicles are presented. A slave nacelle is designed for the ICLS test. Cost and reliability are the important factors considered. The slave nacelle simulates the internal flow lines of the actual Flight Propulsion System (FPS) but has no external fairing. The aerodynamic differences between the ICLS and FPS nacelles are presented, followed by the structural description and analysis of the various nacelle components.

3307 Emission Control

REFER ALSO TO CITATION(S) 33070023070

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 33080022825

22829 (DOE/R3/06100—T1) Development of a system for electronic methanol-water injection for automobile engines. Neely, D.K. (Neeley (Derek K.), Pittsburgh, PA (USA)). 31 Mar 1981. Contract FG43-79R306100. 134p. NTIS, PC A07. File Number DE85009421.

In October of 1979 work was begun to prepare an electronic fuel injection system which could be added to the existing fuel system on standard automobiles. The injection system would permit the injection of additional fuel required to maintain a combustable air/fuel mixture using fuel mixtures consisting of large percentages of methanol with gasoline. The work processed for approximately fourteen months during which time the system operated for thousands of miles of testing. The system showed significant improvements in energy consumption at little or no increase in fuel cost over standard gasoline fuel. The optimum fuel mixtures for minimum energy consumption and lowest fuel cost were in the range between 50% methanol - 50% gasoline and 75% methanol and 25% gasoline.

36 MATERIALS

REFER ALSO TO CITATION(S) 36000022420

22830 (AD-P—004222/6/XAB) Coatings for fuel economy or materials substitution. Coad, J.P.; Scott, K.T. (UKAEA Atomic Energy Research Establishment, Harwell). Apr 1984. 11p. NTIS, PC A02/MF A01.

This article is from the Proceedings of the Meeting of the Structures and Materials Panel (57th) held at Vimeiro, Portugal on 14-19 October 83, AD-A148 598, p 12.1-12.11.

The application of three coating techniques to problems of fuel economy or materials substitution is described. The coating techniques are plasma spraying, Sputter Ion Plating (SIP) and Plasma Assited Vapour Deposition (PAVD), and the applications range from thin coatings for nuclear and aerospace use to free-standing furnance elements.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 36010022418, 22589, 22609, 22624, 22631, 22632, 22639, 22759, 22982, 23278, 23339, 23356

22831 (BDX—613-3227) Aging study of copper alloy 172. Final report. Ulitchny, M.G. (Bendix Corp., Kansas City, MO (USA)). Apr 1985. Contract AC04-76DP00613. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009848.

An evaluation of the effects of aging temperature on the yield strength and toughness of beryllium-copper alloy 172 shows that all the toughness measurements, impact energy, pre-cracked Charpy, and compact tension parallel each other and mirror the tensile strength. An aging schedule which is improved from that currently prescribed has been determined in order to produce an improved combination of strength-toughness. A study of the surface wave velocity as a function of aging temperature has revealed an easy way to determine under-aging or over-aging in this alloy.

22832 (BDX—613-3234) Aging of gold thick-film solder joints. Final report. Becka, G.A. (Bendix Corp., Kansas City, MO (USA)). Mar 1985. Contract AC04-76DP00613. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009847.

Temperature aging effects on 90-degree peel strength and metallization lift-off were determined for soldered gold thick-film connections. Those effects to the 90-degree peel strength and the time at temperature resulting in metallization lift-off were determined. Six indium- or tin-based solder alloys were investigated. The study was performed at room temperature, 50 and 90% of the alloy melting point (or solidus) temperature through 500 h of aging. Sn63 alloy produced the highest peel strength soldered connections of the alloys evaluated, but the alloy consumed the greatest amount of gold in forming intermetallic compounds. Further, metallographic sampling was performed to inspect intermetallic formation between the gold and the tin or indium constitutents.

22833 (CONF-850274—1) High-temperature oxidation of alloys in mixed oxidants. Natesan, K. (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009706.

From International conference on corrosion science and technology; Calcutta, India (21 Feb 1985).

Thermodynamic aspects of high-temperature corrosion processes occurring in complex gas mixtures are discussed, with emphasis on the role of thermochemical diagrams. The interrelationships between the corrosion behavior of materials and gas composition, alloy chemistry, and temperature are examined. A number of examples from studies on materials behavior in oxygen-sulfur environments are used to elucidate the role of thermochemistry in the understanding of oxidation processes that occur in mixed-gas atmospheres. The role of kinetic factors in scale development and breakdown is presented. On the basis of extensive morphological analyses of specimens of a number of alloys exposed to gas mixtures with different chemistries, three regimes were defined to describe the oxidation-sulfidation behavior of the alloys at elevated temperatures, and probable corrosion mechanisms for each were identified. 18 references, 11 figures.

22834 (CONF-850542—3) Thermodynamic properties of liquid Li-Pb, Na-Pb, and K-Pb alloys: similarities and differences. Saboungi, M.L.; Ellefson, J. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004074.

From 167. Electrochemical Society meeting; Toronto, Ontario, Canada (12 May 1985).

The thermodynamic properties (e.g., activities, activity coefficients, entropies, free energies of mixing) have been determined for liquid Li-Pb, Na-Pb, and K-Pb alloys over the entire composition range. For the two latter systems, a solid electrolyte consisting of either Na-βAl_2O_3 or K-βAl_2O_3 was used in the electrochemical cell which was operated by a standard coulometric titration technique. The results show an unusual composition dependence of the excess chemical potential of the alkali metal. For Li-Pb and K-Pb, a single inflection point is obtained at compositions around 20 at. % and 50 at. % Pb, respectively, while three inflection points are present in the Na-Pb system at about 20, 33, and 50 at. % Pb.

22835 **(CONF-8407117—1) Magnetism at interfaces and surfaces, as probed by neutron scattering.** Felcher, G. (Argonne National Lab., IL (USA)). Dec 1984. Contract W-31-109-ENG-38. 13p. NTIS MF A01; 2; GPO Dep. File Number DE85007987.

From Course on dynamical phenomena at surfaces, interfaces and superlattices; Erice, Italy (1 Jul 1984).

The diffraction of polarized neutrons from metal-metal superlattices, with one of the two metal magnetic, has yielded significant information on the microscopic distribution of magnetism, although the ultimate possibilities of the technique are yet sample-limited. Fresnel reflection of polarized neutrons from superconductors and ferromagnets is providing the depth profile of the magnetization close to the surface of these materials.

22836 **(DOE/ER/12065—1) Fatigue of chromium-ferritic steels at elevated temperatures. Final report, July 1, 1982-June 30, 1984.** McEvily, A.J. (Connecticut Univ., Storrs (USA). Dept. of Metallurgy). 1984. Contract AC02-82ER12065. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85007735.

The fatigue crack growth characteristics of ferritic steels 2 1/4Cr-1Mo, modified 9Cr-1Mo, and 9Cr-2Mo steels have been investigated at 538°C in vacuum and compared to results obtained at room temperature. Despite marked differences in initial mechanical properties the fatigue crack growth behavior at 538°C was remarkably similar. Further crack closure was greatly reduced at the elevated temperature leading to a loss of R-dependency on crack growth. Results of room in elevated temperature tests could be correlated by means of the change in Young's modulus. Additional studies of its effect of processing and electron beam welding on low-cycle fatigue properties have also been investigated. Work on creep crack growth of ferritic steels has been initiated. 12 figures, 3 tables.

22837 **(DOE/ER/45158—T1) Experimental and theoretical studies on transport processes in laser welding.** DebRoy, T. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). 25 Mar 1985. Contract FG02-84ER45158. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008572.

Progress has been made in areas related to fluid flow, heat transfer and alloying element loss during laser welding of stainless steels. The progress is reported under the following headings: weld pool temperature, alloying element vaporization rate, and solute loss; absorption of CO_2 laser by stainless steels; numerical calculation of fluid flow in laser melted pools; and microstructure of the welded material. (DLC)

22838 **(DOE/ER/45173—1) Corrosion Research Center of the University of Minnesota progress report, January 1-December 31, 1984.** Oriani, R.A. (Minnesota Univ., Minneapolis (USA). Corrosion Research Center). Feb 1985. Contract FG02-84ER45173. 219p. NTIS MF A01; 2; GPO Dep. File Number DE85009418.

The research is reported in two parts: (1) surface structures and reactions in aqueous corrosion systems, and (2) role of oxide scale morphology and structure on high temperature oxidation and corrosion processes. (DLC)

22839 **(DP-MS—85-10) Strain fields for aluminum at different tooling temperatures and extrusion ratios.** Peacock, H.B.; Berghaus, D.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1985. Contract AC09-76SR00001. 21p. (CONF-850499—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008257.

From 9. conference on advances in the production of tubes, bars and shapes; Cincinnati, OH, USA (22 Apr 1985).

Strain distributions throughout the die region are obtained for axisymmetric extrusion of aluminum billets. Results which include the three extensional strains and accumulated shear are produced from an analysis of experimentally obtained laminar flow lines on extruded specimens. Extrusion experiments are performed at average tooling temperatures of 174°C and 354°C and for extrusion ratios from 1.9 to 12.4. Both tooling temperatures and extrusion ratios affect the magnitude and/or the distribution of plastic strains in extruded aluminum.

22840 **(LBL—18255) Erosion of corrosion-resistant surface treatments on alloy steels.** Levy, A.; Hickey, G. (Lawrence Berkeley Lab., CA (USA)). Jan 1985. Contract AC03-76SF00098. 45p. (CONF-850415—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE85008446.

From 4. international conference on wear of materials; Vancouver, Canada (14 Apr 1985).

Protective coatings of both diffused and sprayed on types are being used to protect chemical process plant and boiler combustor surfaces from elevated temperature corrosion. An investigation was conducted to determine the small, solid-particle erosion behavior of such coatings at room and elevated temperatures. It was determined that no single coating performed in a superior manner to the others and that hardness was not a factor in establishing erosion resistance. The erosion rates decreased from 20° to 500°C. All of the coatings reached steady state erosion rates after 50 to 150g of erodent particles had impacted their surfaces.

22841 **(N—85-10165) Morphological changes of gamma prime precipitates in nickel-base superalloy single crystals.** Mackay, R.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1984. 232p. (NASA-TM—83698; E—2156). NTIS, PC A11/MF A01.

Changes in the morphology of the gamma prime precipitate were examined during tensile creep at temperatures between 927 and 1038 C in 001-oriented single crystals of a Ni-Al-Mo-Ta superalloy. In this alloy, which has a large negative misfit of -0.80%, the gamma prime particles link together during creep to form platelets, or rafts, which are aligned with their broad faces perpendicular to the applied tensile axis. The dimensions of the gamma and gamma prime phases were measured as directional coarsening developed in an attempt to trace the changing morphology under various stress levels. In addition, the effects of initial microstructure, as well as slight compositional variations, were related to raft development and creep properties. The results showed that directional coarsening of gamma prime began during primary creep, and under certain conditions, continued to develop after the onset of steady-state creep. The length of the rafts increased linearly with time up to a plateau region. The thickness of the rafts, however, remained equal to the initial gamma prime size at least up through the onset of tertiary creep this is a clear indication of the stability of the finely-spaced gamma-gamma prime lamellar structure. It was found that the single crystals with the finest gamma prime size exhibited the longest creep lives, because the resultant rafted structure had a larger number of gamma-gamma prime interfaces per unit volume of material.

22842 **(N—85-10166) Effects of cobalt, boron, and zirconium on the microstructure of Udimet 738. Final report.** Nakanishi, T.G. (Purdue Univ., Lafayette, IN (USA)). Sep 1984. 76p. (NASA-CR—174762). NTIS, PC A05/MF A01.

A structural study was carried out on Co modified Udimet 738 alloys containing 0.04, 0.10, and 0.20 wt % Zr at 0.01 and 0.03 wt % B levels. Samples in the as-cast and solution-treated conditions were exposed at 843 C to study structural stability. The structures produced by the interactions of Co, Zr, and B were studied

by SEM, X-ray diffraction, and dispersive analysis techniques. The additions of large amounts of Zr and B were found to increase the solidification range of the U-738. Structural changes involved eutectic gamma prime islands, formation of low melting point compounds, and precipitation of borides and Zr rich phases. Boron and zirconium additions did not show substantial changes in mechanical properties. Removal of Co from the alloys resulted in reduction of the matrix solubility for carbon and increase in the gamma prime solvus. Structural instabilities found were continuous grain boundary M23C6 films, MC breakdown, and plate-like phases. Removal of cobalt resulted in a slight decrease in tensile and stress rupture properties. Detailed structural results presented.

22843 (N—85-11046) Solidification and crystal growth of solid solution semiconducting alloys. Lehoczky, S.L.; Szofran, F.R. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Oct 1984. 1p. NTIS, PC A19/MF A01.

In its 2nd symposium on space industrialization, 320 p. (N—85-11011 02-12).

Problems associated with the solidification and crytal growth of solid-solution semiconducting alloy crystals in a terrestrial environment are described. A detailed description is given of the results for the growth of mercury cadmium telluride (HgCdTe) alloy crystals by directional solidification, because of their considerable technological importance. A series of HgCdTe alloy crystals are grown from pseudobinary melts by a vertical Bridgman method using a wide range of growth rates and thermal conditions. Precision measurements are performed to establish compositional profiles for the crystals. The compositional variations are related to compositional variations in the melts that can result from two-dimensional diffusion or density gradient driven flow effects ahead of the growth interface. These effects are discussed in terms of the alloy phase equilibrium properties, the recent high temperature thermophysical data for the alloys and the highly unusual heat transfer characteristics of the alloy/ampule/furnace system that may readily lead to double diffusive convective flows in a gravitational environment.

22844 (NP—4901586) Evaluation of stress-rupture properties of stainless alloys in fluidized bed combustion environments. Phase 1 report, October 1982-June 1983. Reid, K.G.; Ruscoe, M.J.H. (Sherritt Gordon Mines Ltd., Fort Saskatchewan, Alberta (Canada)). 1983. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84901586.

Phase 1 of the Contract was successfully completed according to the Statement of Work. Stress-rupture tests were carried out on four alloys in a synthetic coal combustion atmosphere. The materials tested were Stainless Alloys 310, 347H and HK40 and Incoloy Alloy 800H. In general, rupture lives at 900°C were similar to those expected from tests in air reported in the literature. This was attributed to the gas having an oxidizing potential at 900°C. At 800°C and at low stress, rupture lives were generally shorter than would have been expected in air. This was attributed to the gas having a sulphidizing potential at 800°C. It was concluded that of the four alloys, Incoloy 800H was least suitable for service in a combustion atmosphere. In preparation for Phase 2 a suitable simulated deposit attachment technique was developed and successfully tested. 22 references, 7 tables.

22845 (NP—5901253) Material modeling and high-speed machining process. Lee, D.; Wilkening, W.W. (General Electric Co., Schenectady, NY (USA). Metallurgy Lab.). Oct 1982. 20p. Technical Information Exchange, Bldg. 5, Room 321, Schenectady, NY 12345. File Number TI85901253.

Orthogonal machining experiments have been conducted at moderate speeds with 6061-T6 aluminum and Ti-6Al-4V titanium alloys to measure strain distributions in the deformed chip, using a grid technique. While the aluminum alloy displayed large uniform strain within continuous chips, the titanium alloy exhibited highly nonuniform strain distributions within segmented chips, a feature known to occur under high-speed machining. Concurrently, a set of simple constitutive equations are formulated in order to describe the plastic flow behavior of materials over wide ranges of strain, strain rate and temperature. Based on experimental data, the proposed form of constitutive equation is capable of simulating stress-strain-strain rate relationships of 6061-T6 aluminum and Ti-6Al-4V over the range of strain rates applicable to the high-speed machining process. Given the constitutive relations, analytical problems that will be encountered in modeling the localized shear process are outlined based on the experimental observations of chip formation. As a step toward modeling the high-speed machining process, a partially successful finite element analysis of a simplified, continuous chip orthogonal machining process was made using the ADINA code. Some of the relevant analytical and experimental results that have been obtained for the aluminum and titanium alloys are examined. 47 references, 14 figures.

22846 (ORNL/TM—9016) Interfacial segregation and fracture. Yoo, M.H.; White, C.L.; Trinkaus, H. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009779.

A brief review is given of the physical mechanisms that control nucleation, growth, and coalescence of intergranular cavities during deformation of polycrystalline materials at intermediate temperatures under low applied stress. The effects of interfacial solute segregation on creep ductility are discussed in terms of its effects on interfacial energies and diffusivities. The available experimental dta on detrimental and beneficial solute effects on creep rupture life of model alloy systems are consistent with the calculated time to rupture. Our limited understanding of the grain-boundary chemistry effects on creep embrittlement of commercial structural alloys is preseted, and further experimental and theoretical studies for the better understanding of controlling mechanisms are suggested. 107 references, 19 figures.

22847 (PNL—5341) Cesium Chloride Compatibility Testing Program. Annual report, fiscal year 1984. Bryan, G.H.; Divine, J.R. (Pacific Northwest Labs., Richland, WA (USA)). Jan 1985. Contract AC06-76RL01830. 69p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009667.

During the course of a prior examination, it was found that one of the aged test capsules exhibited discoloration and pitting on the outer surface of the inner capsule. The damage was attributed to problems encountered in the electropolishing operation, which is used to decontaminate the inner capsule after it is loaded with the CsCl and welded shut. A study was carried out in FY 1984 to: determine if the pitting was associated with the electropolishing operation; identify acceptable solution(s) to the problem; and establish the effect, if any, on the long-term integrity of the capsule. Another special study performed in FY 1984 was that of examining two capsules from the Waste Encapsulation and Storage Facility (WESF) storage pool. The objective was to establish the extent of the capsule corrosion while in storage. The study of cause and long-term consequences of the pitting on the WESF cesium chloride capsules has found: The pitting is caused by a nonuniform current distribution at the rack/capsule contact, which forms localized hot spots. The high temperature causes the acid to become more concentrated through boiling of the acid. The concentrated boiling phosphoric acid causes a high rate of corrosion which forms the crevice. The lack of intergranular attack at the base of the crevices and the favorable results of the mechanical testing leads to the conclusion that there will be no long-term failure mechanism accentuated by the pitting, beyond that of having a small hole in the capsule wall with a consequential thinner wall. An attempt to penetrate the capsule wall by electropolishing failed after 30 min with the loss of electrical contact. Consequently, the maximum wall penetration is 40 mils, out of a total thickness of 136 mil. No justification was found to require examination and repack of the existing capsules. A modification of the rack design is recommended for future work, however, to eliminate the pitting.

22848 (SAND—84-1852) Laser welder for fabricating neutron tubes. Borrego, J.H.; Barnaby, B.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009965.

A laser welder for use on very small vacuum devices fabricated from high-temperature melting point alloys and refractory

metals has been developed at Sandia National Laboratories. Intended primarily for Research and Development, the welder includes a 400-W, pulsed Nd:YAG laser, welding chamber, positioning system, closed-circuit TV monitor, and a computer controller.

22849 (SAND—85-0697C) Weldability/microstructure relationships of high nickel alloys for header applications. Knorovsky, G.A.; Cieslak, M.J.; Headley, T.J. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 4p. (CONF-8504102—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009337.

From 66. AWS annual meeting; Las Vegas, NV, USA (28 Apr 1985).

22850 (SAND—85-0750C) Cavitation-erosion of plasma-sprayed alloys. Smith, M.F.; Bhat, H.; Herman, H. (Sandia National Labs., Albuquerque, NM (USA); Intel Corp., Santa Clara, CA (USA); State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering). 1984. Contract AC04-76DP00789. 6p. (CONF-8410238—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009542.

From American Society for Metals meeting; Long Beach, CA, USA (31 Oct 1984).

Very limited research has been carried out on the cavitation-erosion (CE) resistance of thermal sprayed protective coatings. In the work that has been carried out to date, there appears to be a relation between the nature of the particle-particle cohesive bond and CE behavior. Oxide at the particle interface leads to poor CE resistance. The same can be said for porosity. Improving CE resistance in metal coatings will be consistent with obtaining a dense, low porosity oxide-free deposit.

22851 (UCRL—92349) Study of the equilibrium vacancy ensemble in aluminum using 1D- and 2D-angular correlation of annihilation radiation. Fluss, M.J.; Berko, S.; Chakraborty, B.; Hoffmann, K.R.; Lippel, P.; Siegel, R.W. (Argonne National Lab., IL (USA); Brandeis Univ., Waltham, MA (USA). Dept. of Physics; Lawrence Livermore National Lab., CA (USA); Reactor Research Centre, Kalpakkam (India)). 12 Mar 1985. Contract W-7405-ENG-48. 5p. (CONF-850169—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008967.

From 7. international conference on positron annihilation; New Delhi, India (6 Jan 1985).

One- and two-dimensional angular correlation of positron-electron annihilation radiation (1D and 2D-ACAR) data have been obtained between 293 and 903 K for single crystals of aluminum. The peak counting rates vs temperature, which were measured using the 1D-ACAR technique, provide a model independent value for the temperature dependence of the positron trapping probability. Using these results it is possible to strip out the Bloch state contribution from the observed 2D-ACAR surfaces and then compare the resulting defect ACAR surfaces to calculated 2D-ACAR surfaces for positrons annihilating from the Bloch, monovacancy, and divacancy-trapped states. The result of this comparison is that the presence of an increasing equilibrium divacancy population is consistent with the observed temperature dependence of ACAR data at high temperature in Al and that the present results when compared to earlier studies on Al indicate that the ratio of the trapping rates at divacancies and monovacancies is of order two.

22852 Preparation of γ-LaS/sub y/ (1.33<y<1.50) alloys by the pressure-assisted reaction sintering method and their thermoelectric properties. Takeshita, T.; Gschneidner K.A. Jr.; Beaudry, B.J. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **57**: No. 10, 4633-4637(15 May 1985). Contract W-7405-ENG-82.

The pressure-assisted reaction sintering (PARS) method was used to prepare thermoelectric elements of the γ-phase lanthanum sesquisulfide solid solution alloys which exist over a wide homogeneity range: LaS/sub y/ (1.33<y<1.5). A mixture of powders of stoichiometric lanthanum sesquisulfide (La_2S_3) and lanthanum trihydride (LaH_3) was reaction sintered in a hot-press to make the desired composition of γ-LaS/sub y/. This method produced black dense single-phase γ-LaS/sub y/ pellets with a theoretical density of 97% or better. The thermoelectric properties (electrical resistivity and Seebeck coefficient) of the samples prepared by the PARS technique were measured. The room temperature electrical resistivity and Seebeck coefficient of γ-LaS/sub y/ varied in a systematic manner with the electron concentration indicating that γ-LaS/sub y/ alloys behave like a simple metal. Although the current carriers appear to be quite heavy (drift mobility ~3 $cm^2/V\,s$), the temperature dependence (up to 1000 °C) of these properties of LaS/sub 1.42/ were found to be linear functions, which is in accord with the above observations. The thermoelectric figure of merit based on the measured resistivity and Seebeck coefficient and an estimated thermal conductivity for LaS/sub 1.42/ is $0.75 \times 10^{-3}\ °C^{-1}$ at 1000 °C, which is comparable to those of the state-of-the-art materials such as silicon—germanium alloys at 1000 °C.

22853 Doping level selective photochemical dry etching of GaAs. Ashby, C.I.H. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **46**: No. 8, 752-754(15 Apr 1985).

The first observation of a highly selective photochemical dry etching process which discriminates between semiconductor materials differing in dopant concentrations by less than a factor of 5 is reported here. A photochemical reaction of GaAs with gas phase reactive Cl species occurs when the surface is irradiated with low-intensity light of band gap or greater quantum energies. Application of an appropriate negative bias to a GaAs sample can almost totally suppress the photochemical reaction of heavily doped n-GaAs, while less heavily doped n-GaAs or p-GaAs continue to etch at undiminished rates under the same conditions. This is the first reported etching process to produce greater than 20:1 selectivity for doping levels differing by less than a factor of 5. A mechanism which may explain the origin of the photochemical reaction and the voltage-controlled doping level selectivity which it displays is presented here. The potential significance of these observations for other semiconductor materials, such as Si, is discussed.

22854 Fermi surface study of CeSb. Aoki, H.; Crabtree, G.; Joss, W.; Hulliger, F. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **57**: No. 8, 3033-3035(15 Apr 1985). Contract W-31-109-ENG-38.

A Fermi surface study of the ferromagnetic phase of CeSb is presented. The γ frequency branches arising from the electron surfaces at the X points, three separate frequency branches from the hole surfaces at the Γ point, and the low-frequency branch α have been observed. The effective mass ratios are low and range from ~0.2 for the α branch to ~1.0 for the high-frequency branch of γ. The low effective mass ratios suggest that the admixture of the conduction states with the f state is small. We have observed a drastic change in the appearance of the de Haas—van Alpen signal at the phase transition between the ferromagnetic and lower field antiferromagnetic phases: the low-frequency α oscillation suddenly disappears as the crystal enters the antiferromagnetic phase. By utilizing the change in the signal appearance, the transition field strength has been measured as a function of the field direction. The present experimental results particularly the origin of the α oscillation, are discussed in the light of the p-f mixing theory and recent band-structure calculations based on localized f orbitals.

22855 Superconductivity and magnetism in heavy-electron U intermetallics (invited). Ott, H.R.; Rudigier, H.; Fisk, Z.; Smith, J.L. (Laboratorium fuer Festkoerperphysik, ETH-Hoenggerberg, 8093 Zuerich, Switzerland). *Journal of Applied Physics;* **57**: No. 8, 3044-3048(15 Apr 1985).

Recent work intended to investigate a Fermi-liquid-type low-temperature state in uranium intermetallic compounds is reviewed. In form of a comparison of physical properties with those of $CeAl_3$, the prototype heavy-electron system, some details concerning the occurrence of this heavy-electron state are discussed. Special attention is then given to experimental data giving evidence for superconductivity or magnetic order, both involving these heavy electrons. The possibility of unconventional superconductivity in these systems is supported by increasing experimental evidence.

22856 Anisotropic (triplet) superconductivity in UPt_3 (invited). Batlogg, B.; Bishop, D.J.; Bucher, E.; Varma, C.M.; Fisk, Z.; Smith, J.L. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Applied Physics;* 57: No. 8, 3060-3063(15 Apr 1985).

Ultrasound experiments were performed on single crystals of the heavy Fermion superconductor UPt_3. From the ultrasound attenuation below T/sub c/, a quasiparticle density of states linear in energy is deduced, which we interpret as due to an anisotropic polar-like (triplet) superconducting state. This is further supported by the agreement of the only fitting parameter Δ_0/kT/sub c/ with the theoretical value for polar p-wave pairing. The attenuation in the normal state gives the electron-phonon interaction strength and the product of the deformation potential times the effective mass is found to be the same as for ordinary "light" Fermion systems. The observed variations of the sound velocity are discussed.

22857 Large magnetic field effect on the heavy fermion superconductor U/sub 1-x/Th/sub x/Be_{13} just above T/sub c/. Willis, J.O.; Smith, J.L.; Fisk, Z.; Ott, H.R. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos,New Mexico 87545). *Journal of Applied Physics;* 57: No. 8, 3079-3081(15 Apr 1985). Contract W-7405-ENG-36.

Magnetic fields as small as 4 kOe substantially increase the resistivity of U/sub 1-x/Th/sub x/Be_{13} for x = 0.0175 and 0.0378 between 1.4 K and T/sub c/, the superconducting transition temperature of this heavy fermion material. At the intermediate value of x = 0.026, T/sub c/ reaches a local maximum, and no normal-state field dependence is observed up to 4 kOe. At x = 0.0603, away from the region of nonmonotonic dependence of T/sub c/ on x, again no field dependence is seen. The observations are discussed with regard to specific-heat measurements and in terms of the interaction of superconductivity with narrowband features.

22858 Anisotropic magnetic and superconducting properties of single crystals of $RERh_4B_4$ compounds. Zhou, H.; Chen, J.W.; Lambert, S.E.; Maple, M.B. (Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Journal of Applied Physics;* 57: No. 8, 3115-3117(15 Apr 1985). Contract AT03-76ER70227.

We report the synthesis of small single crystals of several $RERh_4B_4$ compounds where RE = Sm, Gd, Tb, Dy, Ho, Er, and Tm using a flux-growth technique. Measurements of the ac electrical resistance R in zero and applied magnetic fields and dc magnetic susceptibility are reported. The upper critical magnetic field H/sub c/2(T) determined from the resistance measurements for RE = Sm, Er, and Tm are also presented. Considerable anisotropy of H/sub c/2(T) is observed for Er and Tm, while very little is found for Sm.

22859 Crystal-field "dressing" and enhanced magnetoelastic effects. Banerjea, A.; Cooper, B.R. (Department of Physics, West Virginia University, Morgantown, West Virginia 26506-6023). *Journal of Applied Physics;* 57: No. 8, 3188-3190(15 Apr 1985). Contract FG05-84ER45134.

Hybridization of moderately delocalized f electrons with band electrons gives rise to a highly anisotropic two-ion interaction. If a bare, point-charge-like crystal field is included, it is "dressed" by the hybridization both through the two-ion interaction and through the modification of the single-ion interactions. We have investigated the relative effects of the anisotropic two-ion interaction on cubic and tetragonal crystal-field terms in the distorted paramagnetic phase. We have found a difference in the degree and the temperature dependence of the dressing of the two terms. This provides a possible explanation for enhanced magnetoelastic effects in materials such as $CeAl_3$.

22860 Dynamical effects and the critical behavior of random-field systems (invited). Shapir, Y. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* 57: No. 8, 3279-3284(15 Apr 1985). Contract AC02-76CH00016.

A variety of phenomena is observed experimentally in random-field (RF) systems realized by the application of an external field to diluted antiferromagnets. At low temperatures, infinitely long hysteretic effects are manifested by the history dependence of the final states: long-range order is observed if the field is applied after cooling, while domain states are reached when field cooled. While no indications for critical fluctuations are detected in 2-D systems, scaling behavior, for both the correlation length and the specific heat, is observed in 3-D systems over an intermediate range of temperatures. The related critical properties seem to be well described by the corresponding ones in the 2-D pure Ising model. The renormalization-group approach, which yields for the equilibrium critical exponents their values of the pure model in d-2 dimensions, is reviewed. A generalization of the dimensional-reduction approach, which accounts self-consistently for renormalized responses of the RF system, is presented. The dynamical effects are implicitly incorporated through the variation in the critical response between the local and the global regimes, associated with short- and long-time scales, respectively. In both regimes the lower critical dimension is found to be d = 2 in accordance with stability arguments. The short-time critical behavior indicates a dimensional reduction by one for the 3-D thermal exponents, in agreement with the experimental results.

22861 Spatial and dynamic spin correlation of CuMn (5 at. %) spin glass: Inelastic neutron scattering study. Uemura, Y.J.; Shapiro, S.M.; Wenger, L.E. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* 57: No. 8, 3401-3403(15 Apr 1985). Contract AC02-76CH00016.

Neutron scattering experiments have been performed on a spin-glass CuMn (5 at. %, T/sub g/ = 27.6 K). Polarized neutron measurements with coarse energy resolution show no change of instantaneous spatial spin correlation below T = 60 K. Unpolarized neutron studies with fine energy resolution (ΔE = 260 μeV) demonstrate that the slowing down of Mn spin fluctuations occur in the same way for all the wave vectors between 0.2 and 4.0 A^{-1}. These results indicate that the spatial and dynamic spin correlations are completely decoupled in the spin freezing process. We also study the short-range spatial correlation of the "frozen" spins at T = 5 K using a simple model, and demonstrate the importance of the ferromagnetic coupling between the third nearest-neighbor Mn moments.

22862 Coexistence of antiferromagnetism and spin-glass ordering in the Ising system Fe/sub 0.55/Mg/sub 0.45/Cl_2. Wong, P.; Yoshizawa, H.; Shapiro, S.M. (Schlumberger-Doll Research, Old Quarry Road, Ridgefield, Connecticut 06877-4108). *Journal of Applied Physics;* 57: No. 8, 3462-3464(15 Apr 1985).

Fe/sub 1-x/Mg/sub x/Cl_2 is a diluted Ising antiferromagnet with competing first- and second-neighbor exchange interactions. For xroughly-equal45, the system undergoes a Neel transition at T/sub N/ roughly-equal7.4 K and a reentrant spin-glass transition at T/sub sg/ roughly-equal3.0 K. From neutron scattering experiments we find that (i) the antiferromagnetic Bragg peak persists down to 1.2 K, well below T/sub sg/; and (ii) the diffuse scattering becomes temperature independent below about 6.0 K, with the correlation length frozen at about 2.8 lattice spacings. These results suggest that long-range antiferromagnetic order and spin-glass-like short-range order coexist. Such a behavior is predicted by the infinite-range model for spin glasses with strong uniaxial anisotropy.

22863 Magnetic x-ray scattering studies of the rare-earth metal holmium (invited). Gibbs, D.; Moncton, D.E.; D'Amico, K.L. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* 57: No. 8, 3619-3622(15 Apr 1985).

We present the results of recent magnetic x-ray scattering experiments on the rare-earth metal Ho performed using both a rotating anode source and synchrotron radiation. Specifically, we have measured the Ho(00l)$^+$ magnetic satellites in the simple spiral antiferromagnetic phase between 132 and 20 K and in the conical phase below 20 K. Although the cross section for magnetic x-ray scattering is reduced from the usual Thomson cross section by a factor of roughly-equal10^6, the incommensurate magnetic satellites are well separated from the main Bragg peaks. Thus, detection of

the satellites is possible with a rotating anode source and extensive high-resolution studies of them are straightforward with synchrotron radiation. The assembled data are in good agreement with the results of magnetic neutron scattering published previously for different Ho samples.

22864 **Magnetic structure of multiple bilayers of thin films of Fe and Ge.** Majkrzak, C.F.; Axe, J.D.; Boeni, P. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **57**: No. 8, 3657-3659(15 Apr 1985). Contract AC02-76CH00016.

A diffraction study of multiple bilayers consisting of thin films of Fe and Ge was performed using both x rays and polarized neutrons. A reduction in the moment of a fraction of the Fe atoms due primarily to interdiffusion at the interface is indicated.

22865 **Ferromagnetic resonance in a Ni-Mo superlattice.** Pechan, M.J.; Salamon, M.B.; Schuller, I.K. (Department of Physics, Miami University, Oxford, Ohio 45056). *Journal of Applied Physics;* **57**: No. 8, 3678-3680(15 Apr 1985).

Ferromagnetic resonance (FMR) measurements, at room temperature and at 4.2 K, have been made on a layered Ni (249 A)-Mo(83 A) superlattice. We have examined the resonance position as a function of the angle between the film normal and the applied field. The measured g value agrees with that of bulk Ni, but the magnetization is lower than that obtained for bulk Ni and also for this sample using both light scattering and direct measurement techniques. This low magnetization contrasts with FMR measurements on compositionally modulated Ni-Cu samples, where the magnetization was reported to be greater than that of bulk Ni. We show that a reduced value of the magnetization is consistent with perpendicular uniaxial anisotropy. When the applied field is less than 20° from the surface normal, additional lines appear that move to higher fields than the main resonance. These lines are consistent with the existence of nonuniform regions of distinct magnetization. An observed resonance, which is suggestive of a spin-wave mode, is discussed.

22866 **Recent high-resolution neutron inelastic scattering studies of magnetic systems (invited).** Stirling, W.G. (Institut Laue-Langevin, 156X, Grenoble Cedex, France). *Journal of Applied Physics;* **57**: No. 8, 3778-3783(15 Apr 1985).

The advent of highly efficient (neutron) cold sources in research reactors has permitted studies of the excitations in condensed matter with improved instrumental resolution and at much lower energies than previously possible. For example, the triple-axis crystal spectrometer on the ILL cold source permits studies with resolutions in the range from (roughly) 1 to 0.02 meV (20 μeV). Even better resolution, extending below 1 μeV, is provided by the neutron-spin-echo spectrometer. In this article, recent work on magnetic systems, at ILL, using high-resolution inelastic scattering techniques, is briefly reviewed. We shall describe a spin-echo investigation of the critical dynamics of iron and then a series of triple-axis measurements of critical scattering and magnetic excitations in a variety of materials, USb, Rb_2CrCl_4, Pr, Nd, TMMC, $CsCoCl_3$, and, finally, a polarized neutron study of $CsNiF_3$.

22867 **Magnetic and structural properties of shock-synthesized zinc ferrite.** Venturini, E.L.; Morosin, B.; Graham, R.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **57**: No. 8, 3814-3816(15 Apr 1985). Contract AC04-76DP00789.

High-pressure shock-wave loading on stoichiometric mixtures of zinc oxide and ferric oxide powders produces partial conversion to a spinel structure zinc ferrite as shown by x-ray diffraction. The ferrite phase is characterized by a substantial saturation magnetization plus a high-field susceptibility. Since stoichiometric $ZnFe_2O_4$ is paramagnetic above 10 K, the magnetic behavior of the shock-synthesized spinel demonstrates that it is a zinc-deficient ferrite. X-ray diffraction data confirm that less zinc oxide is consumed than ferric oxide in producing the recovered spinel.

22868 **ac susceptibility of thermally annealed and neutron irradiated Cu-Ni alloys.** Catchings III, R.M.; Borg, R.J.; Violet, C.E. (Howard University, Washington, D.C. 20059). *Journal of Applied Physics;* **57**: No. 8, 3435-3437(15 Apr 1985). Contract W-7405-ENG-48.

The effect of thermal annealing and high flux neutron irradiation on the ac susceptibility of Cu-Ni alloys of composition 40, 50, and 60 at. % Ni have been studied. In this compositional region the short-range order and cluster changes introduced by the annealing and irradiation can greatly effect the magnetic state of the Cu-Ni system. Neutron diffraction studies on the Cu-Ni system have indicated the possibility of a miscibility gap forming in this system. The ac susceptibility of samples quenched from high temperature (900 °C), annealed at low temperature (350 °C), or irradiated at the LLNL, RTNS-II 14-MeV neutron source were measured as a function of temperature. The quenched 60 at. % Ni alloy exhibited a ferromagnetic transition near 195 °K that remained unchanged under neutron irradiation. The low-temperature annealed sample gave a transition occurring over a wider temperature range. The quenched 50 at. % Ni alloy exhibits a ferromagnetic transition at a lower temperature with a chi(T) curve that is peaked near 40 °K. The thermally annealed and irradiated sample exhibits a greatly broadened chi(T) curve. The quenched 40 at. % Ni alloy gives a paramagnetic behavior. The low-temperature annealed sample gives a chi(T) curve having a broad plateau that decreases at low temperatures. This behavior is suggestive of a ferromagnetic to spin-glass transition. The irradiated sample gives a chi(T) curve having a peak indicating a spin-glass transition at 2.4 °K.

22869 **Phenomenological theory of icosahedral incommensurate ("quasiperiodic") order in Mn-Al alloys.** Bak, P. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **54**: No. 14, 1517-1519(8 Apr 1985). Contract AC02-76CH00016.

The crystal structure with icosahedral point-group symmetry and long-range orientational order observed by Shechtman et al. in Mn-Al alloys can be explained as a multiple-q density-wave structure with only one length scale. Its existence and stability can be understood from a simple Landau theory. The diffraction spots can be indexed by six- (or more-) dimensional space-group symmetries. Icosahedral incommensurate structures constitute natural extensions of smectic, rodlike, and cubic crystal structures.

22870 **Atom location by axial-electron-channeling analysis.** Pennycook, S.J.; Narayan, J. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review Letters;* **54**: No. 14, 1543-1546(8 Apr 1985). Contract AC05-84OR21400.

The channeling of electrons along or between atomic rows in a crystal is used as the basis of a powerful lattice-location technique capable of analyzing small quantities of crystal impurities with high spatial resolution. We demonstrate the technique by locating Sb dopant in Si and compare the results with ion-channeling and planar-electron-channeling analysis. Delocalization corrections are required with the electron-channeling analyses.

22871 **Polarized neutron study of the paramagnetic scattering from γ-Fe.** Boeni, P.; Shirane, G.; Wicksted, J.P.; Stassis, C. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **31**: No. 7, 4597-4602(1 Apr 1985).

High-resolution polarized and unpolarized neutron scattering experiments have been performed in order to characterize the paramagnetic scattering from the γ-phase (fcc) of metallic iron. Assuming that the width Γ of the energy distribution of the paramagnetic scattering varies like q/sup delta/, the experimental results are consistent with values of δ between 1 and 1.5. Therefore, for γ-Fe, the q dependence of Γ does not follow the behavior predicted for a ferromagnet ($\delta >$ or $=2$) by dynamical scaling. On the other hand, the results demonstrate that the spin-spin correlations in γ-Fe are ferromagnetic in nature, characterized by an inverse correlation length between approximately 0.25 and 1 A^{-1}. This result is consistent with the conclusions reached in recent neutron scattering experiments which were performed on γ-Fe at higher momentum transfers.

22872 **Gas-tungsten arc welding of aluminum alloys.** Frye, L.D. (to Dept. of Energy). US Patent 4,484,060. 20 Nov 1984. Filed date 25 Mar 1982. vp.
PAT-APPL-361932.

A gas-tungsten arc welding method for joining together structures formed of aluminum alloy with these structures disposed contiguously to a heat-damagable substrate of a metal dissimilar to the aluminum alloy. The method of the present invention is practiced by diamond machining the fay surfaces of the aluminum alloy structures to provide a mirror finish thereon having a surface roughness in the order of about one micro-inch. The fay surfaces are aligned and heated sufficiently by the tungsten electrode to fuse the aluminum alloy contiguous to the fay surfaces to effect the weld joint. The heat input used to provide an oxide-free weld is significantly less than that required if the fay surfaces were prepared by using conventional chemical and mechanical practices.

22873 **Method of forming a thin unbacked metal foil.** Duchane, D.V.; Barthell, B.L. (to Dept. of Energy). US Patent 4,481,999. 13 Nov 1984. Filed date 23 Feb 1982. vp.

PAT-APPL-351378.

In a method of forming a thin (<2μm) unbacked metal foil having a desired curviplanar shape, a soluble polymeric film, preferably comprising polyvinyl alcohol, is formed on a supporting structure having a shape that defines the desired shape of the foil product. A layer of metal foil is deposited onto one side of the soluble film, preferably by vacuum vapor deposition. The metallized film is then immersed in a suitable solvent to dissolve the film and thereby leave the metal foil as an unbacked metal foil element mounted on the supporting structure. Aluminum foils less than 0.2 μm (2,000 A) thick and having an areal density of less than 54 μg/cm² have been obtained.

22874 **Tantalum-copper alloy and method for making.** Schmidt, F.A.; Gibson, E.D.; Verhoeven, J.D. (to Dept. of Energy). US Patent 4,481,030. 6 Nov 1984. Filed date 1 Jun 1983. vp.

PAT-APPL-500102.

A tantalum-copper alloy can be made by preparing a consumable electrode consisting of an elongated copper billet containing at least two spaced apart tantalum rods extending longitudinally the length of the billet. The electrode is placed in a dc arc furnace and melted under conditions which co-melt the copper and tantalum to form the alloy.

22875 **Method for determining the hardness of strain hardening articles of tungsten-nickel-iron alloy.** Wallace, S.A. (to Dept. of Energy). US Patent 4,481,470. 6 Nov 1984. Filed date 29 Jul 1981. vp.

PAT-APPL-287966.

The present invention is directed to a rapid nondestructive method for determining the extent of strain hardening in an article of tungsten-nickel-iron alloy. The method comprises saturating the article with a magnetic field from a permanent magnet, measuring the magnetic flux emanating from the article, comparing the measurements of the magnetic flux emanating from the article with measured magnetic fluxes from similarly shaped standards of the alloy with known amounts of strain hardening to determine the hardness.

22876 **Heat treatment of nicrfe alloy to optimize resistance to intergrannular stress corrosion.** Steeves, A.F.; Bibb, A.E. (to Dept. of Energy). US Patent 4,481,043. 6 Nov 1984. Filed date 7 Dec 1982. vp.

PAT-APPL-447727.

A process of producing a NiCrFe alloy having a high resistance to stress corrosion cracking comprising heating a NiCrFe alloy to a temperature sufficient to enable the carbon present in the alloy body in the form of carbide deposits to enter into solution, rapidly cool the alloy body, and heat the cooled body to a temperature between 1100° to 1500° F. for about 1 to 30 hours.

22877 **Study of the T_1[110] phonon dispersion curves of bcc La and bcc Zr.** Stassis, C.; Zarestky, J. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). *Solid State Communications;* **52**: No. 1, 9-12(Oct 1984).

In both metals the frequencies of the T_1 [110] are found to be considerably lower than those of the T_2 branch. This implies a large anisotropy with respect to the propagation of elastic waves, a property which is more typical of simple than of transition metals. The possible implications of these results regarding the stability and the anomalous self-diffusion in these metals are briefly discussed.

22878 **Surface preparation of the S-1 Spheromak flux core liner.** Moore, R.; Macey, C. (Perkin-Elmer Corporation, Edison, NJ (USA). Physical Electronics Div.); Cohen, S.; Janos, A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Thin Solid Films;* **118**: No. 1, 15-21(3 Aug 1984). (CONF-8404135—).

From International conference on metallurgical coatings; San Diego, CA, USA (9 Apr 1984).

Different methods of preparing the S-1 Spheromak flux core liner for exposure to plasma (i.e. cleaning and polishing techniques) were studied with the goal of reducing the net impurity resources available for contaminating the plasma during Spheromak formation. The S-1 Inconel 601 liner is described together with an analysis of topography and surface and/or near-surface composition of various Inconel samples subjected to mechanical, electrochemical and chemical preparation techniques. The general conclusion based on the analysis of the samples is that the different techniques are roughly competitive on the basis of surface composition, while less preparation tends to give better results in terms of the criteria mentioned above. This has helped to simplify the liner preparation.

22879 **Coatings for fast breeder reactor components.** Johnson, R.N. (Hanford Engineering Development Lab., Richland, WA (USA)). *Thin Solid Films;* **118**: No. 1, 31-47(3 Aug 1984). (CONF-840411—).

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Several types of metallurgical coatings are used in the unique environments of the fast breeder reactor. Most of the coatings have been developed for tribological applications, but some also serve as corrosion barriers, diffusion barriers or radionuclide traps. The tribological coatings must meet a variety of performance criteria for friction coefficients, wear rates, galling resistance and self-welding resistance in liquid sodium. In addition, most applications require the coating to exhibit long-term resistance to sodium corrosion, resistance to damage by thermal cycling at temperatures up to 625°C and, for core applications, resistance to irradiation damage to neutron fluences of $6x10^{22}$ neutrons cm^{-2} or more. The materials that have consistently given the best performance as tribological coatings in the breeder reactor environments have been coatings based on chromium carbide, nickel aluminide or Tribaloy 700 (trademark of Cabot Corporation) (a nickel-base hardfacing alloy). Other coatings that have been qualified for limited applications include chromium plating for low temperature galling protection and nickel plating for radionuclide trapping. Processes now employed include detonation gun coating, diffusion coating, electrospark deposition coating and electroplating.

22880 **(LA-tr—85-17) Peaking effect.** Minier, C.; Lauzier, J.; Esnouf, C.; Fantozzi, C. Translated from *Journal de Physique (Paris), Colloque ;* No. 9, C9.51-C9.62(Dec 1983). Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009980. DE85009980

The experimental features of the peaking effect (P.E.) are reviewed and the theoretical models of interpretation are analyzed. 31 references, 12 figures.

22881 **Analytical electron microscopy techniques for track-plated Au-Cu alloy.** Johnson, K.A.; Staudhammer, K.P. (Los Alamos National Lab., NM). *Thin Solid Films;* **108**: 61-67(1983). (CONF-830443—).

From Metallurgical coatings conference; San Diego, CA, USA (18 Apr 1983).

Track-plated material offers improved mechanical properties over conventional plating. Track plating consists of burnishing the deposit during the plating process. The burnishing process, i.e. the mechanical rubbing of the deposit during electrodeposition, produces continuous nucleation of new grains during deposition, which effectively prevents large columnar grains and macroporosity. The unusual property improvement is associated with several significant microstructural features. These include periodic variations in the

deposition chemistry, and an extremely fine grain-subgrain size and concomitant deformation. 3 references, 9 figures.

22882 **Adsorption of O_2 and CO on thin films of palladium.** Vankar, V.D.; Vook, R.W.; De Cooman, B.C. (Syracuse Univ., NY). *Thin Solid Films;* **102**: 313-326(1983). Contract AC02-77ER04496.

The adsorption of O_2 and CO on polycrystalline and (111) monocrystalline thin palladium films formed by vapor deposition has been studied by means of Auger electron spectroscopy (AES), low energy electron diffraction (LEED) and mass spectrometry. The palladium film thicknesses ranged from 15 to approximately 1500 A. The experiments were carried out at 298 K. Surface topographical effects were studied in various ways, one of which was a method consisting of repeated alternating vapor deposition of palladium and gaseous exposure. In all cases studied, no LEED pattern other than the normal Pd(1 x 1) pattern was observed after gaseous exposures up to 600 langmuir of O_2 or 7200 langmuir of CO. However, AES showed clearly that some O_2 and CO adsorbed on polycrystalline and monocrystalline surfaces that were either contaminated or rough. Thick (1500 A) smooth Pd(111) films grown on mica showed no evidence of significant O_2 or CO adsorption, and in both cases the AES intensity ratio of the O(512 eV) line to the Pd(329 eV) line was near zero. 28 references, 10 figures.

22883 **Thermodynamics of order-disorder transformations in vanadium carbide.** Emmons, G.H.; Williams, W.S. (Univ. of Illinois, Urbana-Champaign). *Journal of Materials Science;* **18**: 2589-2602(1983). Contract AC02-76ER01198.

Some of the nonstoichiometric carbides of the transition metals (e.g. VC/sub x/) undergo transformations to ordered phases at specific values of x. In a thermodynamic study of such order-disorder transformations the latent heats of the reactions VC/sub 0.833/ = V_6C_5 and VC/sub 0.875/ = V_8C_7 were measured using differential thermal analysis (DTA) and gave values of 5.7 +/- 2.8 cal g^{-1} and 6.0 +/- 2.4 cal g^{-1} (1 cal = 4.1855 J), respectively. For well-annealed specimens intermediate in carbon-to-metal ratio between these two compositions, DTA indicated the coexistence of domains of both ordered phases. The implication is that the nonstoichiometric, disordered, NaCl-structure phase VC/sub x/ does not represent the lowest energy state of vanadium carbide at room temperature for any value of x. This result may apply to the other isomorphic carbides, i.e. TiC/sub x/, ZrC/sub x/, HfC/sub x/, NbC/sub x/ and TaC/sub x/. The measured temperatures corresponding to the onset of the transformations were 1184 +/- 12°C for V_6C_5 and 1112 +/- 8°C for V_8C_7, but the centre of the distribution was approximately 50°C higher in each case. A rationalization of the existence of first-order transitions and an estimate of the latent heats expected from the measured transition temperatures were attempted using the Bragg-Williams theory of order-disorder transformations. The results are consistent with experiment, though the adequacy of this approximation for such a complex case is questionable.

22884 **Effects of oxygen on quenched-in resistivity measurements of copper.** Mundy, J.N.; Ockers, S.T. (Argonne National Lab., IL). *Journal of Physics F: Metal Physics;* **13**: 2589-2594(1983).

A quenching apparatus was built in which the gaseous environment could be controlled to an oxygen partial pressure of less than 10^{-14} Pa, in order to examine the effect of oxygen on the quenched-in resistivity, Δ rho/sub q/, of thin, high-purity, copper samples. Oxygen was found to significantly affect measurements of Δ rho/sub q/ through internal oxidation of magnetic impurities, through precipitate formation and through changes of the size-effect parameters (surface specularity and bulk mean free path of the electron). The complex interaction of these effects of oxygen on the quenched-in resistivity of copper samples is discussed.

22885 **(CE-Trans—8064) Electrodes for repairing power engineering equipment made from creep resisting steel.** Gotalskii, Yu.N; Snisar, V.V. Translated from *Promyshlennaya Energetika ;* **5**: 11-13(1970). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901225. DE85901225

It has been recommended that defects in casing components belonging to power engineering equipment be repaired with austenitic electrodes in cases where it is impossible to use pre-heating and post-weld heat treatment. In order to prevent the formation of a structure inhomogeneity in the fusion zone between the austenitic and non-austenitic metal the nickel content in the austenitic metal must not be less than 45%. The E.O. Paton Institute of Electric Welding has developed electrodes, type ANZhR-1 (C ≦ 0.1, Si ≦ 0.35, Mn 1.5 to 2.5, Cr 23.0 to 26.0, Ni base, Mo 8.5 to 11.0, Ti 0.05, S ≦ 0.015, P ≦ 0.02), which ensure the formation of a high-nickel austenitic structure in the metal without carbide-forming elements; during welding, the above mentioned structure inhomogeneity in the fusion zone is prevented when heating the weld joint up to 600°C. 9 references, 6 figures, 2 tables.

22886 **(ORNL-tr—5201) Age hardening and atomic structure of an aluminium-6 at. % silver alloy.** Auer, H.; Gerold, V. (Oak Ridge National Lab., TN (USA); Max-Planck-Institut fuer Metallforschung, Stuttgart (Germany, F.R.)). [1985]. Contract AC05-84OR21400. Translation source information not available . 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009977.

Metal research is investigating the connection between structural and qualitative changes with the goal of establishing their quantitative relationship. This report analyses the structural changes of an aluminum-silver alloy during age hardening and after re-conversion.

22887 **(ORNL-tr—5199) Precipitation mechanism in a metallic solid solution crystal. Case of the aluminum-copper and aluminum-silver systems.** Guinier, A. (Oak Ridge National Lab., TN (USA); Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France)). [1985]. Contract AC05-84OR21400. Translation source information not available . 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009981.

Analysis was carried out, through x-ray diffraction, of an oversaturated solid solution monocrystal before and during the precipitation of the new phase. The irregularities of the crystal lattice are revealed by abnormal diffusions outside the selective reflection directions. The dissolved atoms first gather into cores, where they tend to fall in order with the aluminum atoms; then the lattice is transformed. Comparison is made of the intermediate stages in the case of the copper and silver alloys.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 36020022410, 22866

22888 **(CONF-850122—6) Fracture toughness of $MgCr_2O_4$-ZrO_2 composites.** Singh, J.P. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007945.

From 9. annual conference on composites and advanced ceramic materials and workshop on testing methods for ceramic matrix composites; Cocoa Beach, FL, USA (20 Jan 1985).

The effect of unstabilized ZrO_2 inclusions on the fracture surface energy of $MgCr_2O_4$ was studied as a function of ZrO_2 content. It was observed that fracture surface energy increases with increasing ZrO_2 content and reaches the maximum value of 24.5 J/m^2 at 16.5 vol % ZrO_2. This represents an ~ 4-fold increase in the fracture surface energy of $MgCr_2O_4$ as a result of ZrO_2 inclusions. It is proposed that this improvement results from the energy absorbed by the microcracks formed in the $MgCr_2O_4$ matrix as a result of the tetragonal → monoclinic phase transformation of ZrO_2 and the associated volume expansion.

22889 **(CONF-8409117—1) Erosion of multiphase materials.** Anand, K.; Morrison, C.; Scattergood, R.O.; Conrad, H.; Routbort, J.L.; Warren, R. (North Carolina State Univ., Raleigh (USA). Dept. of Materials Engineering; Argonne National Lab., IL (USA); Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Dept. of Engineering Materials). 1984. Contract FG05-84ER45115. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008895.

From 2. international conference on the science of hard materials; Rhodes, Greece (23 Sep 1984).

Erosion rate measurements were made for a series of WC-Co alloys with varying WC-Co grain size and for a fully aligned composite consisting of Al_2O_3 rods in a stainless steel matrix. The microstructure in these multiphase alloys, each containing a brittle and ductile component, has a significant effect on the erosion behavior. In WC-Co alloys, the erosion rate vs angle-of-incidence curves change from a brittle to a ductile signature as the impacting abrasive particle size or particle velocity are increased using target samples with finer WC grain sizes. In the composite, the curves change from a ductile to a brittle signature as the particle size is increased. These effects are attributed to the change in scale of the impact damage event relative to the scale of the microstructure in WC-Co alloys. At small WC grain size, a constraint is imposed on the brittle-fracture erosion process that occurs in the WC grains. For the composite, the microstructural scale is always large and the behavior is due to the relative change in erosion rates for the two components without constraints due to the microstructural scale.

22890 **(DOE/ER/45006—T1) Microstructure-mechanical property relationships in transformation-toughened ceramics. Progress report.** Heuer, A.H. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Metallurgy and Materials Science). 15 Jan 1985. Contract AC02-83ER45006. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009722.

Research on transformation toughened ZrO_2-containing ceramics is underway. We are concentrating on the study of Ostwald ripening in ZrO_2-toughened Al_2O_3 (ZTA), plastic deformation of stabilized ZrO_2 single crystals, and the stress-induced tetragonal→monoclinic martensitic transformation in Y_2O_3-containing tetragonal ZrO_2 polycrystals. The novel experiment in progress is applicable to the entire field of transformation-toughened ceramics.

22891 **(DOE/ER/45012—T1) Limiting processes in laser CVD. Final report, June 1983-June 1984.** Allen, S.D.; Copley, S.M.; Edwards, R.H. (University of Southern California, Los Angeles (USA)). 1984. Contract AT03-83ER45012. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008846.

Preliminary experimental and theoretical research was conducted with the ultimate objective of developing an understanding of the laser chemical vapor deposition (LCVD) process sufficient to predict deposition rates, microstructure, and resulting film properties. SiC deposited on quartz by thermal decomposition of dichloromethylsilane was chosen as the model system. Film thickness profiles, composition, microstructures and film adherence were analyzed. Theoretical support including a preliminary analysis of convective and diffusive transport processes and a finite difference numerical analysis of the laser-generated surface temperature in the substrate was initiated.

22892 **(LA-UR—85-1066) Synthesis chemistry of ceramics by solid-state combustion processes in micro-gravity.** Valone, S.M.; Behrens, R.G. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 11p. (CONF-850357—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009595.

From Spring national meeting of AIChE; Houston, TX, USA (24 Mar 1985).

The method of solid-state combustion offers a way of producing refractory ceramics from the constituent elements. Since temperatures within the reaction zone are so high (2500 to 4000°K), there is probably melting, and surface tension and gravity-induced convection may affect the mixing process. A strongly exothermic reaction can be used to drive a weakly exothermic or endothermic reaction. (DLC)

22893 **(SAND—84-2564C) Ac field-induced order in dense colloidal systems.** Hurd, A.J.; Fraden, S.; Meyer, R.B. (Sandia National Labs., Albuquerque, NM (USA); Brandeis Univ., Waltham, MA (USA). Martin Fisher School of Physics). 1985. Contract AC04-76DP00789;FG02-84ER45084. 12p. (CONF-850267—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009107.

From 2. international conference on ultrastructure processing of ceramics, glasses and composites; Daytona Beach, FL, USA (25 Feb 1985).

The effects of electric fields on colloidal suspensions have been studied for many years, with much attention paid to the various aspects and applications of electrophoresis in static fields. In this paper, we demonstrate experimentally that dipole moments, induced by a strong, alternating external field, can create strong spatial correlations: ordering occurs first as chains of particles, then, at higher fields, as close-packed structures. In addition to being of fundamental interest, these correlations are important for understanding the electrical behavior of dense suspensions. Our objective here is to point out the potential application of electric field effects in ceramics. Since large voids in the particle packing are generally known to decrease the strength of the sintered ceramic, the ideal packing would be a close-packed colloidal crystal. Pressure is commonly applied to densify green bodies, but it seldom produces maximal packing density. The difference in defect distribution may be critical, however. In view of our results, an alternating electric field seems to be a good candidate since it has the additional advantage of being adjustable in strength. In the following sections, we will discuss the basic physics of the ordering phenomenon as well as problems and questions that it raises concerning ceramic powder compaction. 5 references, 3 figures.

22894 **Susceptibility, magnetization, and specific heat in the paramagnetic and ferromagnetic regions of (Y/sub 1-x/U/sub x/)B_4.** Wallash, A.; Crow, J.; Fisk, Z. (Physics Department, Temple University, Philadelphia, Pennsylvania 19122). *Journal of Applied Physics;* 57: No. 8, 3143-3145(15 Apr 1985).

An anomalous magnetic phase diagram for (Y/sub 1-x/U/sub x/)B_4 has previously been reported. This system is paramagnetic for $x>0.6$, ferromagnetic for $0.1<x<0.6$, and paramagnetic for $x<0.1$. Measurements of the magnetic susceptibility suggest a localization of the 5f electrons upon alloying UB_4 with nonmagnetic YB_4 due to a reduction of f-f overlap. The temperature and x dependence of the magnetic susceptibility is consistent with a two site model. This model assumes that the 5f electrons associated with U ions that have four or less nearest neighbors become localized and develop a stable paramagnetic moment. From our analysis, we obtain a paramagnetic moment of (2.6 +- 0.2) μ/sub B/. The saturation moment per U ion for (Y/sub 0.7/U/sub 0.3/)B_4 is (0.32 +- 0.03) μ/sub B/. The specific heat of (Y,U)B_4 shows a substantial enhancement as x decreases but the origin of this enhancement is not understood at this time. These results are presented and discussed in relation to the expected behavior as the system approaches the ferromagnetic instability.

22895 **Muon spin rotation study of V_2O_3.** Denison, A.B.; Boekema, C.; Lichti, R.L.; Chan, K.C.; Cooke, D.W.; Heffner, R.H.; Hutson, R.L.; Leon, M.; Schillaci, M.E. (Department of Physics and Astronomy, University of Wyoming, Laramie, Wyoming 82071). *Journal of Applied Physics;* 57: No. 8, 3743-3745(15 Apr 1985).

Muon spin rotation (μSR) measurements have been made on V_2O_3 as a function of temperature and externally applied magnetic field. V_2O_3 is an insulating antiferromagnet below about 155 K, while above this temperature it is a high-resistivity metal. The conduction arises from the band mechanism where the density of states is quite sensitive to temperature and doping. The local magnetic field, sensed by the positive muon, has been measured from room temperature down to 10 K, with emphasis on the transition region. Clear evidence of the onset of magnetization is provided by a jump in the muon precession frequency. From experiments using an externally applied magnetic field the directions of the internal fields at the muon stop sites are found. This information can be used to determine the muon stop site since the field at this site should be determined primarily by the magnetic dipoles of the V^{3+} ions. Dynamic effects are observed through the muon spin depolarization. The results obtained for V_2O_3 are discussed in the light of similar magnetic-oxide μSR studies and of the electric and magnetic properties of V_2O_3.

22898 Method for forming fibrous silicon carbide insulating material. Wei, G.C. (to Dept. of Energy). US Patent 4,481,179. 6 Nov 1984. Filed date 12 Oct 1983. vp.

PAT-APPL-541196.

A method whereby silicon carbide-bonded SiC fiber composites are prepared from carbon-bonded C fiber composites is disclosed. Carbon-bonded C fiber composite material is treated with gaseous silicon monoxide generated from the reaction of a mixture of colloidal silica and carbon black at an elevated temperature in an argon atmosphere. The carbon in the carbon bond and fiber is thus chemically converted to SiC resulting in a silicon carbide-bonded SiC fiber composite that can be used for fabricating dense, high-strength high-toughness SiC composites or as thermal insulating materials in oxidizing environments.

22897 Mechanical reliability of ceramic windows in high frequency microwave heating devices. Pt. 1. An analysis of temperature and stress distributions. Ferber, M.K.; Kimrey, H.D.; Becher, P.F. (Oak Ridge National Lab., TN (USA)). *Journal of Materials Science;* **19**: No. 11, 3767-3777(Nov 1984).

The temperature and stress distributions generated in ceramic window materials currently employed in microwave gyrotron tubes were determined for a variety of operating conditions. Face-cooled windows of both polycrystalline BeO and polycrystalline Al_2O_3 were considered. The actual analysis involved three steps. First, a computer program was used to determine the electric field distribution within the window at a given power level and frequency. This program was capable of describing both the radial and axial dependence of the electric field. Second, the field distribution was used to derive an expression for the heat generated per unit volume per unit time within the window due to dielectric losses. A generalized heat conduction computer code was then used to compute the temperature distribution based on the heat generation function. Finally, the stresses were determined from the temperature profiles using a finite-element computer program. Primary emphasis was given to determining the effect of frequency upon the resulting thermal stress distribution. In addition, the effects of increasing window diameter and enhancing heat removal from the windows were considered.

22896 Mechanical reliability of ceramic windows in high frequency microwave heating devices. Pt. 2. Mechanical behaviour of the ceramics. Becher, P.F.; Ferber, M.K. (Oak Ridge National Lab., TN (USA)). *Journal of Materials Science;* **19**: No. 11, 3778-3785(Nov 1984).

The mechanical reliability was evaluated for the specific alumina and beryllia ceramics now used as microwave windows in the high-power (>= 200 kW) high-frequency (>= 60 GHz) gyrotron tubes being developed for plasma heating in fusion systems. Previous analysis of the stresses generated in the various window configurations and tube operating conditions indicated that significant tensile stresses are generated in the ceramic window by dielectric heating. As a result, we characterized both the static fatigue behaviour in the fluorocarbon fluid used to cool gyrotron windows and the inert strength distributions for these two ceramics. These data were then analysed in order to construct reliability diagrams for these two materials. Such diagrams revealed that the use of these specific ceramic materials will be limited by their time to failure at the tensile stresses imposed on them under the gyrotron operating conditions. The fatigue behaviour and inert strengths of both materials could be improved by increasing their density and employing a uniform fine grain size. Such material improvements would permit significant increases in the mechanical reliability of the gyrotron microwave window.

22899 Thermomechanical properties of a new composition of sintered Si_3N_4. Greskovich, C.; Pasco, W.D.; Quinn, G.D. (General Electric Corporate Research & Development, Schenectady, NY). *American Ceramic Society Bulletin;* **63**: No. 9, 1165-1170(Sep 1984).

Some high temperature mechanical properties are presented for a new gas-pressuresintered (GPS) composition of Si_3N_4 containing 7 wt% of both $SiBeN_2$ and SiO_2 as densification aids. The average fracture strength in 3-point bending was 597 MPa at room temperature and 553 MPa at 1300°C in air, representing 93% strength retention at 1300°C. The average strength values of GPS Si_3N_4 depended on specimen size, surface finish, pretreatment before mechanical testing, and ceramic processing conditions. At 1300°C the oxidation rate was only 7.4 X 10^{-13} $kg^2m^{-4}s^{-1}$, and the creep rate was unusually low at 4.6 X 10^{-7} h^{-1} for a stress of 69 MPa. Although stress rupture results showed evidence for slight static fatigue via slow crack growth at 1200°C, one specimen survived 276 MPa (40,000 psi) loading for 10,000 h in air. A cavitational creep mechanism appeared to be responsible for strength degradation of GPS Si_3N_4 at high temperatures.

22900 Strength retention in SiC ceramics after long-term oxidation. Becher, P.F. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* **66**: No. 8, 120-121(Aug 1983). Contract W-7405-ENG-26.

The room-temperature flexural strengths of SiC ceramics change with increasing oxidation time at 1200°C. When certain impurities (e.g. alumina, WC, and possibly others) are present, the strength continuously decreases ≈ 50% after 4500 h because of subsurface pit formation. Materials containing B and C or Si exhibit strength increases (≧ 40% after 4500 h). Surface oxide growth rates substantially decrease at times ≧ 1850 h, which corresponds to an increase in cristobalite formation. 7 references, 3 figures.

22901 Elastic distortion fields in the ternary compound K/sub 1-x/ Rb/sub x/ C_8. Chow, P.; Zabel, H. (Univ. of Illinois, Urbana-Champaign). *Synthetic Metals;* **7**: 243-250(1983). Contract AC02-76ER01198.

The binary compound formation K/sub 1-x/ Rb/sub x/ C_8 was studied by in situ X-ray (00l) scans on HOPG material. The elastic distortion field parallel to the c-axis was monitored by the change of the Bragg angle. Simultaneously, we determined the ternary composition by the intensity ratio of the (001) and (002) reflections. The measurements reveal a strong deviation from Vegard's rule of lattice parameter changes in binary alloys. The width of the (002) reflection, measured at a sample temperature of 320°C, is a function of the binary concentration and shows a maximum at x = 0.7. In the small concentration region (x < 0.1 and x > 0.9) we have determined the component of the double force tensor normal to the planes for K and Rb defects, which is in both cases 0.37 eV.

3603 Composite Materials

REFER ALSO TO CITATION(S) 36030022889

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 36040022922

22902 Steric molecular theory for multiple smectic-A phases. Dowell, F. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **31**: No. 4, 2464-2471(Apr 1985).

Molecular-lattice-theory results reveal that the steric (hard-repulsive) packing of rigid cores and partially flexible tails can explain the relative stabilities of the smectic-A_1, smectic-A/sub d/, and higher-temperature and lower-temperature nematic (including reentrant-nematic) liquid-crystalline phases, and the isotropic liquid phase. These phases and transitions between them are presented as a function of temperature, pressure, tail-chain length and flexibility, and orientational and positional order of the molecules for different systems. Critical exponents calculated at the smectic-A/sub d/ to nematic transitions are consistent with an identification of the fraction of one-dimensional positional alignment (i.e., the fraction of segregated packing of cores with cores and thus of tails with tails) of the molecules in the smectic-A/sub d/ phase as an order parameter.

3606 Other Materials

REFER ALSO TO CITATION(S) 36060022391, 22405, 22425, 22425, 22433, 22446, 22458, 22521, 23356

22903 **(DOE/ER/04049—4) Radiation damage in optically transparent materials (zircon). Final technical report, 1970-1978.** Thorpe, A.N.; Senftle, F.E.; Tsang, T.; Briggs, C. (Howard Univ., Washington, DC (USA)). 1978. Contract AS05-76ER04049. 9p. (ORO—4049-4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009472.

A study of natural zircon specimens selected to cover the entire range of radiation damage was undertaken and completed. This damage ultimately affects the density, crystal structure, infrared absorption, magnetic susceptibility, and other parameters. Measurements were made of the thermoluminescence, electron microscopy, infrared and magnetic susceptibility of several suites of zircon. As a result, the alpha radiation damage model has gradually been clarified. The most recent measurement suggest that the magnetic measurements of zircon might be used as a long-term gamma ray dosimeter.

22904 **(DOE/ER/45128—T2) Investigation of charge transport in the thermoelectret state of some ceramics and glasses. Progress report.** Puri, O.P. (Clark Coll., Atlanta, GA (USA). Dept. of Physics). 8 Feb 1985. Contract FG05-84ER45128. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009882.

The four processes by which charge displacement and deposition occurs during electret formation are outlined. The research program is being conducted on lead titinate (sic), zirconia and other materials. (DLC)

22905 **(DOE/ER/45170—1) Theoretical studies on the structures of insulating and metallic glasses. Annual progress report, July 1, 1984-June 30, 1985.** Ching, W.Y. (Missouri Univ., Kansas City (USA)). Jan 1985. Contract FG02-84ER45170. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010022.

The major accomplishments covered in this report are: (1) Successful completion of a study on the band structures of all polycrystalline forms of silicon dioxide. (2) Study of electronic structure of Si/sub x/Ge/sub 1-x/ semiconductor solid solutions. (3) An investigation of crystalline lithium metasilicate and lithium disilicate through structural analysis and band structure calculation. (4) Preparation of canonical potentials and basis functions for all transition metal elements to be used in the electronic structure calculation of metallic glasses. (5) Comparative study of the electronic structures of crystalline Ni_3P and amorphous $Ni_{75}P_{25}$ glass.

22906 **(N—85-11148) Experiments with phase transitions at very high pressure.** Spain, I.L. (Colorado State Univ., Fort Collins (USA)). 1984. 35p. (NASA-CR—174029). NTIS, PC A03/MF A01.

A diamond anvil cell is described which was developed for studying hydrogen and other materials to pressure above 100 PGa, including measurements at low temperature. The benefits of X-ray diffraction using synchrotron radiation and using a fixed anode source are examined as well as the optimization of X-ray diffraction at low temperature. A Ge diode detector was incorporated into apparatus for measuring optical absorption, reflectance, and fluorescence in order to enable luminescence studies and Raman spectra were obtained. Results of experiments on Si, Ge, GaP, InAs, hydrogen, benzene, nitrogen, graphite, and the superconductor CeCu2Si2 are given.

22907 **(NP—4901629) Development of high strength fly ash/Portland cement concrete for precast industry.** Plumat, M.; De Benedictis, V.; Bedard, C. (Canada Cement Lafarge Ltd., Woodstock, Ontario). 1982. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84901629.

This paper reports results of an investigation performed to develop high-strength concrete incorporating increasing amounts of fly ash as an addition to high early strength, (type 30), Portland cement. Three water-to-cement ratios were used: 0.45, 0.40 and 0.35. The reference mixes had no fly ash while the fly ash/Portland cement concrete contained 20%, 30% and 40% of fly ash by weight of cement. The cement dosage was kept constant at 370 kg/m^3. The fly ash was used as partial replacement of the fine aggregate. A superplasticizer was used to maintain the slump at 2-1/2 +- 1/2 inch while an air-entraining agent kept the air content within the desired level of 4.5 +- 1.0%. The results show that the incorporation of fly ash was not accompanied by a significant increase in the 1 day compressive strengths of the concrete when cured at room temperature (23°C +- 2°). At this temperature the fly ash reacts much too slowly and begins to improve the overall properties of concrete at the later age of 28 days. In order to accelerate the anticipated benefits of fly ash on the early strength of concrete, we would suggest to further this study to include heat curing of the concrete as is commonly practiced by the precast industry. 3 references, 3 figures, 11 tables.

22908 **(PB—85-129864/XAB) Investigation of the possibilities to produce active carbon from domestic raw products.** Granbom, O. (Foersvarets Forskningsanstalt, Umeaa (Sweden)). Aug 1984. 17p. (In Swedish). NTIS, PC E03/MF E01.

See also PB85-129872.

A literature investigation was carried out to map the domestic raw products that can be used for preparation of active carbon. A large number of carbonaceous materials can be used but the most important is wood, peat, and coal, which are available within Sweden. The problem is that there is no know-how with respect to production of active carbon. The total need of active carbon in Sweden is low as well (about 1500 ton/year), why a production for the country's need only must be expensive. A further investigation of the use of active carbon in Sweden is suggested to map which qualities and quantities are used. Attention must be devoted to the possibility of regeneration and when treatment with active carbon can be discarded or replaced with other adsorbing materials.

22909 **(PB—85-129872/XAB) Investigation of the possibilities to produce carbon black from domestic raw products.** Granbom, O. (Foersvarets Forskningsanstalt, Umeaa (Sweden)). Aug 1984. 21p. (In Swedish). NTIS, PC E03/MF E01.

See also PB85-129864.

A literature investigation was carried out to map the domestic raw products that can be used for preparation of carbon black. The investigation was directed towards a substitute for aromatic hydrocarbon mixtures extracted from petroleum or coal and used in the oil-furnace process. Such feedstock is used in the only plant for carbon black in Sweden (Nordiska Philblack AB in Malmo). A survey of the total domestic raw product resources in Sweden has been carried out but no resource great enough has been found. A potential raw product is lignin, which is a compound build up of aromatic structures. Lignin is a great resource which can be obtained from black liquor from sulphate cellulose plants and is therefore suggested to be investigated if it can be transformed to a feedstock for the oil furnace process. Also turpentine oil, which also contains aromatic compounds is suggested to be investigated even if this is a small resource. The importance of waste as a resource is pointed out. Thus it must be economical to hold a plant for recovery of rubber (together with carbon black) in readiness in case of blockade conditions.

22910 **(PNL-SA—12997) Raman studies of laser damaged single and multi-layer optical coatings.** Exarhos, G.J.; Morse, P.L. (Pacific Northwest Labs., Richland, WA (USA); Air Force Weapons Lab., Kirtland AFB, NM (USA)). Feb 1985. Contract AC06-76RL01830. 23p. (CONF-850345—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009431.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

Structural changes in dielectric optical coatings induced thermally or by high energy pulsed laser irradiation have been studied by the nondestructive technique of Raman Spectroscopy. A two laser (damage, probe) arrangement was used to characterize the damage process in crystalline and amorphous TiO_2 and ZrO_2 coatings on silica during irradiation and at longer times following

the onset of damage. Raman measurements were also undertaken to assess the effects of coating phase and microcrystalline grain orientation on laser induced damage in TiO_2. Results suggest that certain phases have higher damage thresholds for comparable coating thicknesses and that thermal and electronic excitation effects are important considerations for modeling the damage process.

22911 (SERI/TP—212-2576) Morphology of GaAs/sub 1-x/P/sub x/ superlattices grown by MOCVD and chloride VPE. Blakeslee, A.E.; Kibbler, A.; Wanlass, M.W. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1985. Contract AC02-83CH10093. 20p. (CONF-840877—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002944.

From International conference on superlattices, microstructures and microdevices; Champaign-Urbana, IL, USA (13 Aug 1984).

Distorted layer growth manifested by nonuniform etching may occur in GaAs/sub 1-x/P/sub x/ superlattices grown by MOCVD and VPE. The distortion was found to be more severe for MOCVD growth than for VPE. The distortion is decreased by decreasing the magnitude of the interlayer strain in the superlattice but does not depend upon the layer thickness. The rate of crystal growth, the temperature of growth and the strain rate in the layer supporting the superlattice also influence the distortion. Several possible causes of the effect are discussed, including nonuniform elastic stress and/or compositional nonuniformity. 12 references, 6 figures.

22912 (UCRL—89886) Predamage threshold electron emission from insulator and semiconductor surfaces. Siekhaus, W.J.; Kinney, J.H.; Milam, D. (Lawrence Livermore National Lab., CA (USA)). 5 Feb 1985. Contract W-7405-ENG-48. 14p. (CONF-8410186—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008968.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (15 Oct 1984).

Predamage electron emission shows a dependence on fluence, bandgap and wavelength consistent with multiphoton excitation across the bandgap and inconsistent with avalanche ionization and thermionic emission models. The electron emission scales with pulselength as $1/\sqrt{T}$. 6 references, 8 figures, 1 table.

22913 Evidence of chemical ordering in amorphous hydrogenated silicon carbide. Tafto, J.; Kampas, F.J. (Metallurgy and Materials Science Division, Brookhaven National Laboratory, Upton, New York 11973). *Applied Physics Letters;* **46**: No. 10, 949-951(15 May 1985).

Amorphous Si/sub 0.68/C/sub 0.32/:H prepared by radio frequency glow discharge from a mixture of methane and silane was studied by means of the complementary techniques of electron energy-loss spectroscopy and electron diffraction. The experimental results are consistent with Si and C forming a tetrahedral network with nearest neighbor distances similar to those in crystalline Si and crystalline SiC. There is evidence that the C atoms tend to be surrounded by four Si atoms rather than a random distribution of C and Si on the tetrahedral network.

22914 Optical studies during pulsed CO_2 laser irradiation of ion-implanted silicon. James, R.B.; Narayan, J.; Wood, R.F.; Ottesen, D.K.; Siegfriedt, K.F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **57**: No. 10, 4727-4731(15 May 1985).

The time-resolved optical reflectivity (at 633-nm wavelength) of ion-implanted silicon is measured during and immediately after CO_2 laser irradiation [λ = 10.6 μm, pulse duration (FWHM) = 70 ns] as a function of the energy density of the laser. For a heavily doped sample and incident energy densities greater than 2.9 J/cm², the reflectivity of the probe beam is found to rapidly jump to 70%, which is consistent with the reflectivity of liquid silicon. The high-reflectivity phase lasts for up to 1 μs, indicating a relatively deep molten layer as compared to similar annealing experiments with a visible or ultraviolet laser. The transmittance and reflectance (at 10.6-μm wavelength) of ion-implanted silicon are also reported as a function of the energy density of the CO_2 laser. For energy densities slightly exceeding a threshold value, the transmittance (reflectance) of the tailing edge of the pulse is found to greatly decrease (increase). The interpretation of the optical measurements is based on a thermal model in which surface melting occurs for incident energy densities exceeding a threshold value.

22915 Raman and photoluminescence spectra of GaAs/sub 1-x/Sb/sub x/. Cohen, R.M.; Cherng, M.J.; Benner, R.E.; Stringfellow, G.B. (University of Utah, Salt Lake City, Utah 84112). *Journal of Applied Physics;* **57**: No. 10, 4817-4819(15 May 1985). Contract AT03-81ER10934.

The first experimental Raman and photoluminescence spectra are presented for the metastable alloy GaAs/sub 1-x/Sb/sub x/ grown by organometallic vapor phase epitaxy throughout its miscibility gap extending from x = 0.2 to x = 0.75. The phonon peak halfwidths are found to broaden by nearly a factor of 2 over halfwidths found in the binary compounds GaAs and GaSb. Phonon line shapes become more asymmetric in the miscibility gap as the selection rules break down; in addition, a second peak appears for samples grown near the center of the miscibility gap. Line shapes are analyzed and the phonon coherence length is found to be reduced from several hundred angstroms in GaAs to approximately 60 A in samples grown in the miscibility gap. The compositional dependence of the room-temperature band-gap energy has been found to closely follow earlier predictions.

22916 Random-field critical behavior of a d = 3 Ising system: Neutron scattering studies of Fe/sub 0.6/Zn/sub 0.4/F_2. Belanger, D.P.; King, A.R.; Jaccarino, V. (Physics Department, Brookhaven National Laboratory, Upton, Long Island, New York 11973). *Physical Review [Section] B: Condensed Matter;* **31**: No. 7, 4538-4547(1 Apr 1985).

The effects of random fields on the critical scattering of neutrons in a d = 3, diluted Ising antiferromagnet have been observed for the first time. The experiments were made on the same crystal of Fe/sub 0.6/Zn/sub 0.4/F_2 in which earlier birefringence (Δn) studies showed a sharp phase transition T/sub c/(H) to exist. Only the scattering in the region above T/sub c/(H) was studied, where hysteretic behavior is absent. In this equilibrium region, new random-field critical behavior is observed, indicative of an approach to a sharp, second-order phase transition at T/sub c/(H), unlike the d = 2 case where rounding of the phase transition occurs within the same region. Hence the lower critical dimensionality of the equilibrium random-field Ising model (RFIM) is bounded by 2< or =d/sub l/<3. The critical scattering is well described by $S(q) = A/(\kappa^2+q^2)+B/(\kappa^2+q^2)^2$, with A scaling as κ/sup eta-bar/ and B as κeta-bar. A preliminary analysis yields nu-bar = 1.0 +- 0.15, gamma-bar = 1.75 +- 0.20, and eta-bar≈(1/4) for the random-field thermal correlation length (κ^{-1}), staggered susceptibility (chi/sub st/), and correlation function (<S_0/sup z/ S/sub r// sup z/>) critical exponents, respectively.

22917 Method and apparatus for producing high purity silicon. Olson, J.M. (to Dept. of Energy). US Patent 4,481,232. 6 Nov 1984. Filed date 27 May 1983. vp.

PAT-APPL-498999.

A method for producing high purity silicon includes forming a copper silicide alloy and positioning the alloy within an enclosure. A filament member is also placed within the enclosure opposite the alloy. The enclosure is then filled with a chemical vapor transport gas adapted for transporting silicon. Finally, both the filament member and the alloy are heated to temperatures sufficient to cause the gas to react with silicon at the alloy surface and deposit the reacted silicon on the filament member. In addition, an apparatus for carrying out this method is also disclosed.

22918 Growth and physical properties of $ZnGeAs_2$. Shah, S.I.; Greene, J.E. (Univ. of Illinois, Urbana). *Materials Letters;* **2**: No. 2, 115-118(Oct 1983). Contract AC02-76ER01198.

Single-phase polycrystalline chalcopyrite-structure $ZnGeAs_2$ ingots with an average grain size of 70 μm have been grown using a modified vertical Bridgman apparatus. The melting point of the compound was determined by differential thermal analysis (DTA) to be 860°C and corrected X-ray diffraction (XRD) peak positions

were obtained. The crystals were p type with a room-temperature carrier concentration of 1.1 x 10^{19} cm^{-3} and a corresponding mobility of 15 cm^2/V s. A possible chalcopyrite-to-sphalerite phase transition, reported previously to occur to 812°C, was not observed either by DTA or by XRD of quenched samples. 9 references, 4 figures.

22919 **Thermal properties of Na_2O $3SiO_2$ glasses with high water content.** Tomozawa, M.; Takata, M.; Acocella, J.; Watson, E.B.; Takamori, T. (Rensselaer Polytechnic Inst., Troy, NY). *Journal of Non-Crystalline Solids;* **56**: 343-348(1983). Contract AC02-79ER10453.

$Na_2O.3SiO_2$ glasses with various water contents (up to ~ 8wt%)[2] were prepared under high pressure, hydrothermal conditions and their thermal properties were analyzed by DTA and dilatometry. The glass transition temperature (Tg) determined by the two methods agreed reasonably well. Exsolution of dissolved water occurs at temperature above Tg and is accompanied by foaming. Both the glass transition temperature and the foaming temperature decrease with increasing water content, while the thermal expansion coefficient increases with increasing water content. The change of the glass transition temperature with water content was compared with equations applicable to polymer plasticizers, and was found to be best described by an equation which takes the different contribution of hydroxyl ions and molecular water into account. It was concluded that the hydroxyl ions lower Tg drastically while the molecular water lowers it only slightly by merely diluting the glasses. 12 references, 6 figures.

22920 **Magnetic properties of $REFe_2Si_2$ compounds.** Umarji, A.M.; Noakes, D.R.; Viccaro, P.J.; Shenoy, G.K.; Aldred, A.T.; Niarchos, D. (Argonne National Lab., IL). *Journal of Magnetism and Magnetic Materials;* **36**: 61-65(1983).

Structural, magnetization and Moessbauer measurements are reported on $REFe_2Si_2$ (RE = La, Ce, Nd, Gd, Er). In contradiction with earlier reports, all these compounds contain only one type of Fe atom with no magnetic moment on it. The antiferromagnetic phase of Nd, Gd and Er compounds produces hyperfine magnetic fields at half of the Fe sites and no field at the other half. This permits us to predict the antiferromagnetic structure. La and Ce compounds show weak paramagnetic behavior indicating tetravalent Ce and trivalent La atoms in these structures.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 40010022312, 22313, 22320, 22321, 22371, 22835, 22882, 22943

22921 **(AD-A—149164/6/XAB) Toxic hazards tests for vehicles and other equipment. Test Operations Procedure.** (Army Test and Evaluation Command, Aberdeen Proving Ground, MD (USA)). 14 Dec 1984. 25p. (TOP—2-2-614). NTIS, PC A02/MF A01.

Supersedes Report. No. TOP-2-2-614, dated 17 January 1977, AD-A040 542.

This Test Operations Procedure (TOP) describes tests to measure certain toxic-gas and toxic-metal concentrations produced during the operation of equipment, such as the firing of vehicle armament and the operation of engines, fuel-fired personnel heaters, and other fuel-burning equipment (e.g., generators, compressors). Topics include: Contaminants (Toxic Hazards) Summary, Carbon monoxide, Ammonia, Sulfur dioxide, Oxides of nitrogen, and Lead; Instrumentation -- Continuous-reading instrumentation, Colorimetric methods, Gravimetric methods, and Instrument selection; Required Test Conditions -- All test items, and Preparation of test item; Test Procedures -- Weapons (gun and rocket related), and Vehicles and other fuel-burning equipment; Data Presentation -- Exposure limits, Test results, and Methods of computation; Appendices -- Standards, and Procedures for testing for lead, copper, and other metal concentrations during weapon firing tests.

22922 **(BNL—51847) Polymer research at synchrotron radiation sources: symposium proceedings.** Russell, T.P.; Goland, A.N. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Jan 1985. Contract AC02-76CH00016. 198p. (CONF-8410112—). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85008488.

From Symposium on polymer research at synchrotron radiation sources; Upton, NY, USA (29 Oct 1984).

The twenty-two papers are arranged into eleven sessions entitled: general overviews; time-resolved x-ray scattering; studies using fluorescence, ion-containing polymers; time-resolved x-ray scattering; novel applications of synchrotron radiation; phase transitions in polymers; x-ray diffraction on polymers; recent detector advances; complementary light, x-ray and neutron studies; and neutron scattering studies. Seven of the papers are processed separately; three of the remainder have been previously processed. (DLC)

22923 **(CONF-840408—) Nuclear methods in environmental and energy research: proceedings of fifth international conference.** Vogt, J.R. (ed.). (Missouri Univ., Columbia (USA)). Apr 1984. Contract FG02-84ER60193. 887p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE84017348.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

The conference includes papers in the areas of: (1) gamma-ray and x-ray spectroscopy and software, (2) environmental and geochemical methods and applications; (3) energy methods and applications; (4) nuclear and atomic methodology; and (5) biological and medical methods and applications. Papers have been individually abstracted for the data base. (ACR)

22924 **(CONF-850142—3) Digital filters for application to data analysis in electron energy loss spectroscopy.** Zaluzec, N.J. (Argonne National Lab., IL (USA)). Jan 1985. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007932.

From Arizona State University centennial symposium on high-resolution electron microscopy; Tempe, AZ, USA (7 Jan 1985).

Characteristics of difference, top-hat, and second-order top-hat digital filters are discussed. In order to illustrate the usefulness of these filters in EELS, K and L edges in NiO and M shell edge in molybdenum were processed. (DLC)

22925 **(DOE/ER/04049—T1) Feasibility of infrared analysis of iron in zircon.** Heard, I. Jr. (Howard Univ., Washington, DC (USA)). May 1980. Contract AS05-76ER04049. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009427.

A feasibility study has concluded that quantitative infrared analysis can be employed to determine the concentration of iron in zircon. The spectral transmission curves have shown that the iron absorption band is located at 1.15 microns. These curves also revealed a second absorption band at 1.49 microns. The source of this second peak is not known; but it exhibits some features which suggest its dependance on natural α-recoil damage. 23 references, 14 figures, 2 tables.

22926 (DOE/ER/10275—1B, pp 41) **Use of boron nitride to improve sensitivity of neutron activation analysis.** Cook, P.C. (Univ. of Michigan, Ann Arbor). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

22927 (DOE/ER/10275—1B, pp 43) **Provenience determination of Mesoamerican obsidian using neutron activation analysis.** Graham, C.C.; Vogt, J.R.; Glascock, M.D.; Cobean, R.H. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

22928 (DOE/ER/10489—20) Synergistic extraction studies of trivalent actinides and lanthanides using crabs, crowns, and crypts. Ensor, D.D.; Shah, A.H. (Tennessee Technological Univ., Cookeville (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA)). 1984. Contract AS05-79ER10489. 6p. (CONF-841210—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008546.

From International chemical congress of Pacific Basin Society; Honolulu, HI, USA (16 Dec 1984).

This report will describe the investigations of the synergistic characteristics of the novel neutral oxygen donors 1,13-bis-(quinolyl)-1,4,7,10,13-pentaoxotridecane (K-5), a crab; 4-tert-butylcyclohexo-15crown-5(15-C-5), a crown; and 5,6,14,15-dibenzo-4,7,13,16,21,24-hexaoxo-1,10-diazabicyclo[8,8,8]-hexacosane (222BB), a cryptate, for trivalent lanthanides and actinides in combination with HTTA. 3 references, 2 tables.

22929 (DOE/ER/10489—21) Investigation of the solution properties of the transuranium elements. Final report, July 1, 1979-September 30, 1984. Ensor, D.D. (Tennessee Technological Univ., Cookeville (USA). Dept. of Chemistry). 1984. Contract AS05-79ER10489. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009041.

This final report summarizes the significant results obtained during our investigation of the fundamental solution properties of the transuranium elements for the period July 1, 1979 to September 30, 1984. Primary interest of the project was the development of improved separation methods for the trivalent actinide elements from each other and from the chemically similar trivalent lanthanide elements using solvent extraction techniques. Two different synergistic systems were investigated. The combination of dialkynaphthalenesulfonic acids with a crown ether or an oxime was an attempt to combine the excellent ion exchange properties of the sulfonic extractant with a synergistic agent which would improve the selectivity of the extraction system. The results showed that the presence of the crown ether improved the extraction of the light lanthanides by approximately 50% while the heavy lanthanides were unaffected. The use of the oxime in combination with the sulfonic acid extractant showed significant enhancement for all metal ions studied but little, if any, selectivity. The use of novel oxygen donors as synergistic agents in combination with thenoyltrifluoroacetone provided significant enhancement for the extraction of trivalent lanthanides and actinides. The data showed the best selectivity was obtained using a linear polyether as the synergistic agent. The crown ether and the cryptand showed significant synergistic capabilities but lacked selectivity due to their rigid cavities. The results of this study indicate that the linear polyether is more promising as a synergistic agent because of its flexibility and ease of chemical modification of the end groups. 10 figures, 5 tables.

22930 (N—85-10164) Study of proton and neutron activation of metal samples in low Earth orbit. Laird, C.E. (Eastern Kentucky Univ., Richmond (USA)). Oct 1984. 5p. (NASA-CR—171183). NTIS, PC A02/MF A01.

The analysis of the gamma-ray spectra taken from samples flown in Spacelab 1; the search for and review of neutron and proton activation cross-sections needed to analyze the results of the Long Duration Exposure Facility (LDEF) activation measurements; additional calculations of neutron induced activation for the LDEF samples; the data analysis plan for the LDEF and Spacelab 2 samples; the measurement of relevant cross-sections with activation of samples of V, Co, In, and Ta at the Indiana University Cyclotron Facility; and the preparation of an extended gamma-ray calibration source through the development of a proper technique to accurately deposit equal quantities of radioactive material onto a large number of point on the source are discussed.

22931 (SAND—84-2297) Analysis of anions in geological brines using ion chromatography. Merrill, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009497.

Ion chromatographic procedures for the determination of the anions bromide, sulfate, nitrite, nitrate, phosphate, and iodide in brine samples have been developed and are described. The techniques have been applied to the analysis of natural brines, and geologic evaporites. Sample matrices varied over a range from 15,000 mg/L to 200,000 mg/L total halogens, nearly all of which is chloride. The analyzed anion concentrations ranged from less than 5 mg/L in the cases of nitrite, nitrate, and phosphate, to 20,000 mg/L in the case of sulfate. A technique for suppressing chloride and sulfate ions to facilitate the analysis of lower concentration anions is presented. Analysis times are typically less than 20 minutes for each procedure and the ion chromatographic results compare well with those obtained using more time consuming classical chemical analyses. 10 references, 14 figures.

22932 Detection of trace elements with resonance ionization and time-of-flight mass spectrometry. Williams, M.W.; Beekman, D.W.; Swan, J.B.; Arakawa, E.T. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **56**: No. 8, 1348-1350(Jul 1984). Contract W-7405-ENG-26.

A versatile instrument is described for the quantitative indentification of any specified element, except He or Ne, in a gaseous or solid sample. A laser tuned to an excitation level in an atom of the element of interest identifies the element, while a time-of-flight mass spectrometer provides isotopic analysis. With the proper lasers, this method could be employed as a detector of ultratrace quantities of most elements. To demonstrate the method, chromium in a stainless steel sample has been detected. A tunable dye laser selected the Cr atoms present and a mass spectrum of the four stable isotopes of Cr was produced. One application would be to monitor for threshold limit values of elements in the work place. 18 references, 4 figures.

22933 Correlation of elution orders in different liquid chromatographic systems without analyte identification. Synovec, R.E.; Yeung, E.S. (Iowa State Univ., Ames). *Analytical Chemistry;* **56**: No. 8, 1452-1457(Jul 1984). Contract W-7405-ENG-82.

To optimize the separation of unidentified components in a mixture, or to obtain quantitative information about the components prior to identification, the elution orders of the components when different columns or different eluents are used must be determined. Such a procedure for correlating peaks in liquid chromatography is presented for the refractive index detector. The concept is based on a consistency test derived from three of these unidentified chromatograms. With very few exceptions, one of the N! elution orders can be chosen based on a least-squares criterion. A confidence level can also be specified for the chosen elution order. This concept is demonstrated for a four-component mixture as eluted from two different columns using three different eluents. 10 references, 1 figure, 3 tables.

22934 Quantitative ion chromatography without standards by conductivity detection. Wilson, S.A.; Yeung, E.S.; Bobbitt, D.R. (Iowa State Univ., Ames). *Analytical Chemistry;* **56**: No. 8, 1457-1460(Jul 1984). Contract W-7405-ENG-82.

Nonsuppressed ion chromatography with a conductivity detector is used to study solutions of ions. A quantitative method is demonstrated which is based on the detector response using first an eluent with a high equivalent ionic conductance and then an eluent with a low equivalent ionic conductance. One can thus predict the number of equivalents and the equivalent ionic conductance of unidentified ions. The individual charges of the ions are deduced from a study of the adjusted retention times, so that the molar concentrations can be determined. The method does not require any prior knowledge of the identity of the sample ion or any of its physical properties. 12 references, 1 figure.

22935 Standard methods for chemical, mass spectrometric, spectrochemical, nuclear, and radiochemical analysis of uranium hexafluoride. pp 329-412 of 1984 Annual Book of ASTM Standards. Volume 12.01. Section 12. Philadelphia, PA; ASTM (1984).

These methods cover procedures for subsampling and for chemical, mass spectrometric, spectrochemical, nuclear, and radiochemical analysis of uranium hexafluoride (UF_6). All of these methods are in routine use to determine conformance to UF_6 specifications in the Department of Energy (DOE) gaseous diffusion plants or at other DOE installations.

22936 **Determination of trace elements in coal and other energy-related materials by inductively-coupled plasma emission spectrometry after collection on a poly(dithiocarbamate) resin.** Mahanti, H.S.; Barnes, R.M. (Univ. of Massachusetts, Amherst). *Analytica Chimica Acta;* **149**: 395-400(1983). Contract AC02-77EV04320.

Trace elements in energy-related materials (coal, residual fuel oil, and shale oil) are quantified by inductively-coupled plasma atomic emission spectrometry after separation and preconcentration with a poly(dithiocarbamate) chelating resin. Trace elements were determined in coal (NBS 1632a), in a residual fuel oil (NBS 1634a), and in a shale oil (TOSCO). Detection limits ranged from a low of 2 ng ml^{-1} for manganese to a high of 150 ng ml^{-1} for lead. Relative standard deviations ranged from 1 to 5% and deviations from certified values (coal and residual fuel oil) were in the same range for fourteen elements. Recoveries of 1-5 μg of twelve elements added to the shale oil ranged from 96 to 99.5%. 23 references, 5 tables.

22937 **Determination of major, minor and trace elements in bone by inductively-coupled plasma emission spectrometry.** Mahanti, H.S.; Barnes, R.M. (Univ. of Massachusetts, Amherst). *Analytica Chimica Acta;* **151**: 409-417(1983). Contract AC02-77EV04320.

Inductively-coupled plasma emission spectrometry (i.c.p.e.s.) is applied to the measurement of the concentrations of twenty elements in human and animal bone (IAEA H-5) samples. Hydride and elemental generation i.c.p.e.s. are employed for the determination of arsenic, selenium and mercury, and electrothermal vaporization-i.c.p.e.s. is used for the verification of copper. For low concentration levels of eight elements (Cd, Cu, Co, Mo, Ni, Pb, Ti, V), a poly(dithiocarbamate) chelating resin provides a 30-fold preconcentration factor and separation from the matrix prior to the spectrometric measurement. 28 references, 5 tables.

22938 **(ORNL-tr—5192) Gas-chromatographic mass-spectrometric investigation of volatile constituents of wine. Part V. Alcohols, hydroxy esters, lactones and other polar components of wine flavor.** Schreier, P.; Drawert, F. Translated from *Chemie Mikrobiologie Technologie der Lebensmittel ;* **3**: 154-160(1974). Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007719. DE85007719

Aroma compounds obtained by liquid-liquid extraction of wines of the varieties Riesling, Rulaender, Traminer and Scheurebe have been fractioned on silicagel by means of the column-chromatography. After separation of the nonpolar compounds by pentane 84 aroma substances have been separated and identified by means of the combination gaschromatography-mass-spectrometry in the polar fractions of the pentane-ether-, ether- and methanol-elutions. Among these components we found 33 alcohols, 16 polar esters, 9 lactones, 8 secondary amides, 8 volatile phenolic compounds and 7 constituents of furanoic or pyranoic structure. Moreover, the sulphur containing compounds have been identified by means of an attached flame photometric detector. Regarding the flavor of various wines, the specifities of the varieties are essentially determined by quantitative differences of the aroma compounds. Those aroma substances descending from the grapes, particularly the terpen-alcohols and the furanoic and pyranoic derivates are very important. The mass spectrometrical data of 25 aroma compounds, identified for the first time in wines are reported. 112 references, 2 tables.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 40020022285, 22371

22939 **(AD-A—149390/7/XAB) Infrared study of isotopic exchange during methanation over supported rhodium catalysts; an inverse spillover effect. Technical report.** Henderson, M.A.; Worley, S.D. (Auburn Univ., AL (USA). Dept. of Chemistry). 7 Jan 1985. 15p. (TR—3). NTIS, PC A02/MF A01.

Infrared spectroscopy has been employed to study the reduction of carbon dioxide on supported catalyst films. The investigation included isotopic labeling using deuterium as the reduction gas. Isotopic exchange was observed for both carbon dioxide/D2 and methane/deuterium mixtures. The mechanism of this isotopic exchange involves migration of hydrogen from the support to the rhodium sites, an inverse spillover effect. A key intermediate in the dissociation of carbon dioxide on the supported Rh films was a carbonyl hydride species.

22940 **(DOE/PC/50796—T8) Diffusion of gases in porous solids - simulation and measurements. Tenth quarterly progress report, October 16, 1984-January 15, 1985.** Evans, J.W. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). 1985. Contract FG22-82PC50796. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008870.

Progress has been made on the theoretical aspects of this research. A number of Monte Carlo simulations for ordinary gas diffusion in Swiss cheese solids have now been completed. The results are plotted in the attached figure along with results for simulations of diffusion in cannonball solids which were included in last month's report. Also included in this figure are classical theoretical curves for transport in heterogeneous media. The results of the Monte Carlo simulations agree well with the classical theories. It should be noted that the simulation results and the classical theories are at odds with two frequently used correlations for the tortuosity factor, T, purporting to represent gaseous diffusion in porous solids: $T = 1/E$, where E = porosity and $T = 1/E^2$. 1 figure.

22941 **Variational transition state theory with least-action tunneling calculations for the kinetic isotope effects in the $Cl+H_2$ reaction: Tests of extended-LEPS, information-theoretic, and diatomics-in-molecules potential energy surfaces.** Tucker, S.C.; Truhlar, D.G.; Garrett, B.C.; Isaacson, A.D. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Chemical Physics;* **82**: No. 9, 4102-4119(1 May 1985).

We apply conventional and variational transition state theory with least-action-ground-state and other transmission coefficients to calculate the rate constants and kinetic isotope effects for the reaction $Cl+H_2 \rightarrow HCl+H$. First we consider collinear reactions and compare the calculated results to accurate quantal results for a given potential energy surface. This tests the dynamical methods and shows that they are reliable enough for testing potential energy surfaces. We then make calculations for the three-dimensional reactions employing 11 potential energy surfaces that have been proposed in previous work. Seven of the surfaces are extended LEPS surfaces, as proposed by Persky, Klein, and Stern; Truhlar, Magnuson, and Garrett; and Valencich and co-workers; one is an information-theoretic-bond-order-plus-anti-Morse-bend surface (called AL/AB) proposed by Agmon, Levine, Truhlar, Magnuson, and Garrett; and the final three surfaces are a diatomics-in-molecules-plus-three-center-terms surface proposed by Baer and Last and two diatomics-in-molecules surfaces proposed by Isaacson and Muckerman. Three of the surfaces (the final surface of Persky, Klein, and Stern; the first surface of Truhlar, Magnuson, and Garrett; and the AL/AB surface: all of which have relatively symmetric saddle points) are shown to be more reasonable than the others for predicting the rate constants and the H_2/D_2 and the HD/DH kinetic isotope effects. The calculations also indicate that the room temperature rate constants are dominated by quantum mechanical tunneling.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 40030022290, 22371, 22928, 22929, 22939, 22940

22942 **(CONF-8406192—2) Structural and physical studies on a new class of low-dimensional conducting material: FeOCl intercalated with TTF and related molecules.** Averill, B.A.; Kauzlarich, S.M.; Teo, B.K.; Faber, J. Jr. (Argonne National Lab., IL (USA)). Jan 1985. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009701.

From International conference on the physics and chemistry of low-dimensional synthetic metals; Abano-Terme, Italy (17 Jun 1984).

Intercalation of TTF (tetrathiafulvalene), TTN (tetrathianaphthalene), and related organosulfur electron donors into FeOCl results in a significant expansion along the interlayer (b) axis, with the organosulfur molecules apparently inclined with respect to this axis. Electronic spectra suggest that the intercalates are semiconductors with band gaps of ca. 0.4 - 0.5 eV, consistent with previous conductivity data. Elastic neutron diffraction data (10°K) show that magnetic ordering of the FeOCl host is abolished upon intercalation. 11 references, 1 figure, 1 table.

22943 **(DOE/ER/13256—1) Continuous chemical reaction chromatography. Progress report, November 1983-February 1985.** Aris, R.; Carr, R.W. Jr. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1985. Contract FG02-84ER13256. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009812.

The following projects have been completed: (1) countercurrent moving bed reactor (CCMBR) theory; (2) countercurrent moving bed reactor experiments; and (3) countercurrent moving bed adsorber (CCMBA). Some of the highlights are as follows: (1) mathematical analyses of the CCMBR show that for both the ideal reactor model (in which it is assumed that adsorption equilibrium is attained, and dispersion is negligible) and for the reactor with finite dispersion and finite adsorption rate, appropriate operating conditions for A = B lead to simultaneous reaction and separation; (2) comparison of the CCMBR with the performance of a fixed bed shows that the latter can be exceeded in both yield and product purity; (3) experimental investigations of the hydrogenation of mesitylene in the laboratory scale CCMBR has been completed, and the results have been described in a manuscript; and (4) an ideal model of the CCMBA has been completed. Current work on the simulated CCMBR is described covering general considerations, general equations of the system, further considerations, and qualitative aspects of experimental design. 11 figures.

22944 **(DOE/ER/45107—1) Photophysical studies of triplet exciton processes in pure polymer films. Technical progress report, July 28, 1984-February 15, 1985.** Burkhart, R.D. (Nevada Univ., Reno (USA)). 1985. Contract FC08-84ER45107. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008571.

The major objective of the work being carried out on this project is the reliable determination of the speed and migratory range of triplet excitons in pure polymer films. To achieve this objective, the work has been partitioned into two broadly defined subdivisions. These involve the development of experimental methods on the one hand and the determination of suitable polymer substrates on the other. Under the heading of methods development, the most important one is the project involving high intensity laser excitation followed by transient absorption. A system based on an XeCl excimer laser has been constructed and tested on a monomeric system 1,2-benzanthracene (BNZ). A second method being investigated involves the preparation of polymers having terminal groups specifically tailored for energy absorption at one end, energy emission at the other end and triplet exciton conduction between the two. Several polystyrene samples having terminal acetophenone-like units (the unique absorber) and naphthalene units (the emitter) have been prepared and are currently under study. A third area of study involving methods is associated with the kinetics of inter-versus intramolecular exciton migration in polymer solutions.

22945 **(IS-T—1001) Chemistry of 2,3-dimethylene-2,3-dihydrofurans and other reactive olefins prepared by the flash vacuum pyrolysis of substituted furylmethyl esters.** Cassady, T.J. (Ames Lab., IA (USA)). Mar 1985. Contract W-7405-ENG-82. 288p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85009226.

The flash vacuum pyrolysis chemistry of a series of methyl-substituted, furfuryl benzoates and methyl-substituted, 3-furylmethyl benzoates has been investigated. Mechanisms were proposed for the formation of the pyrolysis products, from each of the compounds studied, which involved either α or β eliminations of benzoic acid after one or more [3,3] sigmatropic shifts of the benzoate group. These reactions provide a method for the preparation of the bis(methylene)-dihydrofurans which are the furan analogs of the ortho- and para-quinodimethanes, an actively investigated group of reactive intermediates. The chemical reactions of the 2,3-bis(methylene)-2,3-dihydrofurans, which were investigated in this study, included thermal dimerization reactions, Diels-Alder reactions and chelatropic reactions with sulfur dioxide. Pyrolysis of diesters of 3,4-bis(hydroxymethyl)-2,5-dimethylfuran formed furanoradialene as the only major, nonpolymeric product. Warming the product solutions to room temperature converted furanoradialene into one [4+2] dimer. Several approaches toward the synthesis of [2.2.2.2.]-(2,3,4,5)furanophane were investigated. The failure to produce the desired furanophane was attributed to a retro[4+4] reaction which occurred during the pyrolysis of 4,4'-bis(acetoxymethyl)-5,5'-dimethyl-[2,2](2,3)furanophane. 277 references, 15 figures, 6 tables.

22946 **Malonaldehyde equilibrium geometry: A major structural shift due to the effects of electron correlation.** Frisch, M.J.; Scheiner, A.C.; Schaefer H.F. III; Binkley, J.S. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **82**: No. 9, 4194-4198(1 May 1985).

Complete theoretical optimizations of the equilibrium geometry of malonaldehyde have been carried out within the framework of the self-consistent-field (SCF) approximation. Both Huzinaga—Dunning double zeta plus polarization (DZ+P) and Pople 6—31G** basis sets have been used, resulting in very similar results. The predicted O x x x H hydrogen bond distance is 1.88 A, in poor agreement with the value 1.68 A deduced from experiment. It appears that the Hartree—Fock approximation is incapable of describing the equilibrium geometry of malonaldehyde in a qualitatively correct manner. However, second-order perturbation theory yields a structure (O x x x H distance 1.69 A) in good agreement with experiment. The structures of the keto tautomer and the transition state for symmetric intramolecular hydrogen transfer have also been determined, as have harmonic vibrational frequencies for all stationary points.

22947 **Temperature dependence of the nonexponential decay of photoproduced N,N,N',N'-tetramethylbenzidine cation radicals in sodium dodecylsulfate micelles: Determination of activation energy distributions and relation to dynamic cooperativity.** Plonka, A.; Kevan, L. (Department of Chemistry, University of Houston, Houston, Texas 77004). *Journal of Chemical Physics;* **82**: No. 9, 4322-4325(1 May 1985).

The temperature dependence of the decay of photoproduced N,N,N',N'-tetramethylbenzidine cation radicals (TMB^+) in sodium dodecylsulfate (SDS) micellar solutions was studied with and without added sodium chloride. The distributions of activation energies g(E) associated with the lifetime distributions f(tau) for the cation radical decay were determined. The f(tau) distributions over a range of 287 to 328 K were determined from the inverse Laplace transform of the radical cation decay curves described by [TMB]/[TMB]$_0$ = exp[-t/tau$_0$)/sup α/]. The g(E) distributions show a maximum at about 1.5 of the theoretical potential energy maximum for single bond rotation in isolated hydrocarbon chains which is consistent with values estimated for constrained environments. This supports the importance of cooperativity as the origin of time dependent decay of embedded species in constrained environments such as micelles.

22948 **Thermal decomposition of ions. Part 1. Pyrolysis of protonated ethers: activation energies and A factors.** Sieck, L.W.; Meot-Ner, M. (National Bureau of Standards, Washington, DC). *Journal of Physical Chemistry;* **88**: No. 22, 5324-5327(1984).

Unimolecular rate constants (k/sub d/) have been measured at the high-pressure limit for the thermal decomposition of protonated dimethoxyethane (glyme) and bis(2-methoxyethyl) ether (diglyme). In both cases the decomposition involves loss of CH_3OH and formation of an oxycarbonium ion. The variation of k/sub d/ with temperature gives log A = 11.1 and E/sub a/ = 21.1 kcal mol^{-1} for the pyrolysis of $(glyme)H^+$ and log A = 13.7 and E/sub a/ = 30.7 for $(diglyme)H^+$. To the best of our knowledge these are the first Arrhenius parameters ever determined for the decomposition of cations in the vapor phase under equilibrium conditions at

the high-pressure limit. The data and thermochemistry are consistent with a transition state in which electron shifts result in the disruption of an internal hydrogen bond.

22949 **Hydrocarbon bond dissociation energies.** McMillen, D.F.; Golden, D.M. (SRI International, Menlo Park, CA). *Annual Review of Physical Chemistry;* 33: 493-532(1982). Contract AC03-79ER10483.

The best available values for homolytic bond dissociation energies (BDEs) of various classes of neutral compounds are considered in this review. (BDEs in ionic species is a legitimate subject that is touched on briefly and could easily be included in a longer review. The same can be said for heterolytic BDEs, which are not reviewed as such, although some of the ionic thermochemical data discussed yield values for these processes.) The major emphasis is on hydrocarbons and their nitrogen, oxygen, sulfur, halogen, and silicon-containing derivations, but limited data for inorganic molecules are included. The focus is particularly on prototypical radicals whose heats of formation, formerly thought to be well in hand, have recently been called into serious question. The intent is to include all the major types of sigma bonds, if not all specific cases where known or estimatable heats of formation allow bond dissociation energies to be generated. This review attempts to acknowledge all the standard techniques for measuring BDEs in polyatomic molecules and to offer critical analysis of selected portions of the literature. This leaves values that the authors recommend as the most likely to be correct at the time of this writing. 246 references, 9 tables.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 40040022722

4005 Photochemistry

REFER ALSO TO CITATION(S) 40050022349, 22488, 23211

22950 **(LBL—18651) Adiabatic approach in the theory of polyatomic photodissociation: application to C_3N_2.** Lester, W.A. Jr.; Kresin, V.Z.; Dateo, C.E. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 11p. (CONF-8411153—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008515.

From International conference on lasers '84; San Francisco, CA, USA (26 Nov 1984).

An adiabatic method for nuclear motion has been developed and applied to single-photon predissociation of C_3N_2. The theoretical predictions are in good accord with recent measured product energy distributions. 15 references, 1 figure.

22951 **Photoionization yield and electron thermalization range spectra of N,N,N',N'-tetramethyl-p-phenylenediamine (TMPD) in tetramethylsilane.** Lee, K.; Lipsky, S. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Chemical Physics;* 82: No. 8, 3650-3655(15 Apr 1985).

The fractional change in the fluorescence yield psi/sub F/ of TMPD in tetramethylsilane, due to imposition of an electric field of strength E = 45.6 kV/cm, has been determined at 44 discrete excitation energies, ϵ, above the photoionization threshold from ϵ = 4.77 to 7.52 eV. Two maxima are clearly resolved in the field quenching ratio, (Δpsi/sub F//psi/sub F/^{0})/sub E/, one at 5.71 eV and the other at 6.79 eV. Beyond 7.0 eV, (Δpsi/sub F//psi/sub F/^{0})/sub E/ is again observed to slowly increase. For each of 12 of the previous excitation energies, (Δpsi/sub F//psi/sub F/^{0})/sub E/ was obtained as a function of E from 18.2 to 45.6 kV/cm. Using an exponential radial distribution function of geminate pair separation distances, f(r) = β^3e/sup -betar//2, the field dependence was fitted to the Onsager theory and the average electron thermalization range, $\langle r \rangle = 3/\beta$ extracted as a function ϵ. With this, the yield of thermalized electrons, phi/sub plus-or-minus/ was also obtained as a function of ϵ. The range spectrum is found to increase with increasing ϵ with an inflection at 5.9 eV, followed by a rapid rise to a maximum of 230 A at 6.7 eV and then to decline continuously to 167 A at 7.5 eV. The photoionization yield spectrum shows two maxima, one at 5.7 eV with phi/sub plus-or-minus/ = 0.44 and a second at 6.9 eV with phi/sub plus-or-minus/ = 0.52. Beyond 7.0 eV, phi/sub plus-or-minus/ increases to 0.57 at ϵ = 7.5 eV.

4006 Radiation Chemistry

22952 **(DOE/ER/60159—2) Role of the local environment on the radiation chemistry of biological molecules: proline in single crystals. Progress report, August 1, 1984-July 31, 1985.** Nelson, W.H. (Georgia State Univ., Atlanta (USA)). 1985. Contract AS05-83ER60159. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009881.

The purpose of this project is to investigate the nature of local influences on the radiation-induced chemistry of biological molecules. The long-range idea is that radiation biology results from molecular events. However, study of molecular events is most effectively performed using model systems. On the other hand, biological systems present a complex molecular environment to any single molecular system. Thus, extrapolation of the results from model systems to truly biological ones requires knowledge of the possible effects arising from neglect of the true environment. Efforts in this study are focussed on the amino acid proline. This system was chosen for primarily pragmatic reasons. In several preliminary studies evidence was found that the local environment (e.g., water, HCl) affected the quantity and type of end products. Moreover, the proline system was available in several different environments which had been fully characterized structurally by x-ray or neutron diffraction. As discussed more fully in this report, additional results from the proline family have been obtained. Also, significant results were obtained from a non-proline system, guanine hydrochloride monohydrate. 4 reference, 2 figures.

22953 **ESR study of the guanine cation.** Close, D.M.; Sagstuen, E.; Nelson, W.H. (Department of Physics, East Tennessee State University, Johnson City, Tennessee 37614). *Journal of Chemical Physics;* 82: No. 9, 4386-4388(1 May 1985).

It has been proposed that the primary direct radiation damage products in DNA are guanine cations and thymine anions. Experiments reported here characterize a guanine cation observed in a single crystal of guanine:HCl:H_2O. ESR experiments were performed by x-irradiating and observing the crystals at 15 K. Spectral parameters for the cation include N_3 and N_{10} hyperfine couplings, a C_8—H/sub α/ hyperfine coupling, and two small exchangeable couplings presumably from the N_{10} protons. The computed spin densities of rho(N_3) = 0.283, rho(N_{10}) = 0.168, and rho(C_8) = 0.182 agree nicely with those observed for the guanine cation in DNA. In the single crystal the native molecule is protonated at N_7. It is proposed that once the native molecule is oxidized it rapidly deprotonates at N_7 to form the cation observed.

4007 Radiochemistry And Nuclear Chemistry

22954 **(AD-A—149088/7/XAB) Guidelines - design to minimize contamination and to facilitate decontamination of military vehicles and other equipment: interiors and exteriors. Special publication for period ending June 1982.** Hill, T.E.; Robinson, C.V.; Tierney, J.M.; Thompson, J.H. (Battelle Columbus Labs., OH (USA)). Aug 1984. 532p. NTIS, PC A23/MF A01.

This report provides guidelines for designing military vehicles and other equipment to minimize contamination by nuclear, biological, and chemical agents and to increase the effectiveness of decontamination processes. These guidelines do not presume to dictate requirements for the layout, configuration, or construction of military hardware, nor do they prohibit presently used design techniques. Problems of contamination and decontamination are brought to the attention of designers. Approaches to reduce the size of these problems are suggested.

22955 (DOE/ER/03898—T1) Hot atom reactions involving multivalent and univalent species. Final report. Tang, Y.N. (Texas A and M Univ., College Station (USA). Research Foundation). 1984. Contract AS05-76ER03898. 18p. NTIS MF A01; 2; GPO Dep. File Number DE85008639.

The main achievements of this contract are in three areas: (1) radiotracer catalytic studies, (2) recoil Carbon-11 atom reactions, and (3) recoil Silicon-31 atom reactions. In radiotracer catalytic studies, we have shown that the major effect of activated carbon as a supporting material is to shift the absorbed hydrogen from the Pd(100) and Pd(110) surfaces to the Pd(111) surface. In the recoil Carbon-11 studies, the results suggest that a direct double bond insertion process is operative at high energy. In addition, these results indicate that while singlet carbon atoms are selective in undergoing double bond interactions, triplet carbon atoms are the sole reactants in the C-H insertion process. In the recoil Silicon-31 studies, we have established the formation of silylenes such as $^{31}SiF_2$ in these systems. We have studied the interactions of ^{31}Si atoms and $^{31}SiF_2$ with alkenes and dienes to give silacyclopentenes or silacyclopentadienes.

22956 Decontaminating metal surfaces. Childs, E.L. (to Dept. of Energy). US Patent 4,481,090. 6 Nov 1984. Filed date 23 Jan 1984. vp.

PAT-APPL-573252.

Radioactively contaminated surfaces can be electrolytically decontaminated with greatly increased efficiencies by using electrolytes containing higher than heretofore conventional amounts of nitrate, e.g., >600 g/l of $NaNO_3$, or by using nitrate-containing electrolytes which are acidic, e.g., of a pH<6.

22957 Heat capacity (8 to 350 K) of PuHsub(1.9), heat capacity (340 to 600 K) of PuHsub(2.0), and recommended thermodynamic properties of PuH_3 to 600 K. Oetting, F.L.; Hodges, A.E. III; Haschke, J.M. (Rockwell International Corp., Golden, CO (USA). Energy Systems Group); Flotow, H.E. (Argonne National Lab., IL (USA)). *Journal of Chemical Thermodynamics;* **16**: No. 11, 1089-1102(Nov 1984).

The low-temperature heat capacity of PuHsub(1.9), where the major plutonium isotope was ^{242}Pu, has been determined from 8 to 350 K. The results of this investigation at 298.15 K have been adjusted to correspond to stoichiometric plutonium dihydride: PuH_3. Standard molar thermodynamic quantities were obtained for PuH_3 at T = 298.15 K. Values are given for C°sub(p,m)(T); S°sub(m)(T); (H°sub(m)(T)-H°sub(m)(0)); and -(G°sub(m)(T)-H°sub(m)(0))/T. These have been combined with experimental high-temperature heat capacities (340 to 600 K) of a sample of PuHsub(2.0), where the major plutonium isotope is ^{239}Pu, to give the thermodynamic functions of PuH_3 over the temperature range from 298.15 K to 600 K.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 40080022349, 22356, 22395, 23070

22958 (AD-A—148101/9/XAB) Catalytic ignition and combustion of lean mixtures. Final report. Law, C.K. (Northwestern Univ., Evanston, IL (USA). Dept. of Mechanical Engineering). 1984. 160p. NTIS, PC A08/MF A01.

Ignition and heat-release rates of fuel/oxygen/nitrogen over platinum wires are experimentally studied using micro-calorimetry, aiming to gain additional understanding on the complex transport and kinetic processes involved during catalytic oxidation so as to relate the macroscopic observables with the microscopic behavior. The fuels studied are propane, butane, propylene, ethylene, carbon monoxide, and hydrogen. Parameters investigated include catalyst surface temperature, fuel and oxygen concentrations, and flow velocity. Results show that, for very low Reynolds number flows, the flow velocity has negligible influences on the ignition temperature. Its influence on the heat release rates is also negligible but only for the reactions in kinetically controlled regime. Variation of fuel concentration is found to be an important factor in that the ignition temperatures of propane and butane decrease as their concentrations are increased from lean to rich mixtures while the opposite trend is observed for propylene, ethylene, carbon monoxide and hydrogen.

22959 (AD-A—149041/6/XAB) Reaction of oxygen-nitrogen mixtures with granular activated carbons below the spontaneous ignition temperature. (Geo-Centers, Inc., Newton Upper Falls, MA (USA)). Aug 1984. 29p. (GC-TR—84-385). NTIS, PC A03/MF A01.

The presence of oxygen in the carbon network of gas-adsorbent charcoals presents a research problem of long standing. Four pertinent topics now concerned with the oxygen-charcoal reactions are: a) activation of the adsorbent charcoals (manufacture), b) regeneration processes (applications), c) the spontaneous ignition temperature (safety considerations), and d) the use of charcoals as catalyst carriers and impregnation supports. It is desirable to have a deeper knowledge of the initial surface composition of a charcoal that is to be used in a specific process. Thermal desorption behavior can supply such information. The results to be reported cover three characteristic temperature-dependent phenomena: 1) an anomalous desorption in which a number of maxima occur in the concentrations of CO and CO_2; 2) the formation of a surface barrier causing a decay in the CO and CO_2 concentrations with the first-order rate constants at constant temperature; and 3) the attainment of a reproducible spontaneous ignition temperature (SIT) during programmed heating at a linear rate. These observations indicate a considerable complexity in the surface structure of an activated carbon.

22960 (AD-A—149106/7/XAB) Fuels combustion research. Annual report, 1 March 1983-29 February 1984. Dryer, F.L.; Glassman, I.; Williams, F.A. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 18 Jul 1984. 52p. NTIS, PC A04/MF A01.

Further oxidation studies of the n-alkylated aromatics reveal insights with respect to the oxidation of the alkyl side chains. Toluene is unique in its oxidation due to the nonreactivity of the benzyl radical that forms. The higher normal alkyl aromatics all form styrene and allyl radicals during the initial stages of oxidation. Thus the oxidation of these fuels will all be similar to ethyl benzene. The first results on the oxidation 1-methyl naphthalene have been obtained. A study on the oxidation and pyrolysis of butadiene, an important aromatic intermediate and soot precursor, has been completed. More extensive experimentation on the sooting tendencies in premixed and diffusion flames has been performed. The new fuels used were the cycloalkanes, the cycloolefins, purified 1,3-butadiene and 1-methyl naphthalene. A new model for sooting under premixed conditions reveals that original fuel structure does not play a role in soot production, but the number of carbon-carbon bonds in the fuel do. Diffusion flame results confirm that fuel pyrolysis rates and intermediates determine the sooting tendency in this combustion system. The new theory of boron ignition and combustion has been improved further. Appropriate droplet generators for boron and carbon slurries have been developed.

22961 (AD-A—149154/7/XAB) Investigation of fuel-additive effects on sooting flames. Annual scientific report, 1 May 1983-30 May 1984. Bonczyk, P.A. (United Technologies Research Center, East Hartford, CT (USA)). 25 May 1984. 17p. (UTRC/R—84-956545). NTIS, PC A02/MF A01.

Experiments in progress are described which have as their objective the clarification of the mechanisms responsible for soot suppression in flames by fuel additives. Measurements have been carried out in small well-defined diffusion flames for both gaseous and liquid fuels. Data have been obtained for selected organic and inorganic compounds of Ba, Fe, K and Mn as additives. The experimental techniques either employed or projected for use in the near term are in-situ by virtue of their reliance on nonperturbing laser-optical diagnostics. These techniques are Mie scattering, laser-induced fluorescence and coherent anti-Stokes Raman scattering to measure soot size and concentration, additive and other species concentrations and flame temperature, respectively. For gaseous fuels, inorganic salts of the above metals have been evaluated as additives in an ethylene/air flame. Additive suppression of soot was demonstrated, and particulate size, concentration and volume frac-

tion were measured throughout the flame. Significantly, additive effectiveness varied with measurement position, and dissimilar metal behaved differently with respect to their alteration of soot parameters. In addition to particulate measurements, Ba additive chemical states in the flame have been identified from their optical emission spectra, and laser-induced fluorescence measurement has been demonstrated for a molecule closely identified with one of the latter states. For liquid fuels, ferrocene (dicyclopentadienyl iron) has been evaluated as an additive in wick and cylindrical counterflow diffusion flames.

22962 **(DOE/ER/04939—7) Measurement of radical species concentrations and polycyclic aromatic hydrocarbons in flames by fluorescence and absorption using a tunable dye laser. Progress report, March 1, 1982-February 28, 1985.** Salmon, J.T.; Peterson, D.L.; Nagy, P.A.; Laurendeau, N.M. (Purdue Univ., Lafayette, IN (USA). School of Mechanical Engineering). Mar 1985. Contract AC02-78ER04939. 26p. (COO—4939-7). NTIS, PC A03/MF A01; GPO Dep. File Number DE85008624.

The primary goal of this research is to develop quantitative laser fluorescence methods for measuring the concentrations of radical species and polycyclic aromatic hydrocarbons (PAH's) in flames. The accuracy of the fluorescence techniques is evaluated through comparison with independent diagnostic methods. The applicability of the techniques over a range of flame conditions is evaluated by performing the fluorescence experiments in a flat flame burner operated at a variety of flame pressures, temperatures and equivalence ratios. Previously we have demonstrated quantitative laser-saturated fluorescence (LSF) measurements of OH concentration in hydrogen/oxygen/argon flames over wide ranges of flame pressure and stoichiometry. Over the current period of the grant we have (1) extended the OH analysis to atmospheric pressure methane-air flames under both clean and sooting conditions; (2) conducted LSF measurements of NH in a subatmospheric methane-nitrous oxide flame; (3) improved the calibration procedure used to obtain number densities from the fluorescence measurements; (4) investigated the effects of non-uniform laser illumination on LSF measurements; (5) detected hydrogen atom fluorescence in a flame using laser-induced two-photon absorption; (6) developed a technique for measuring the concentrations of PAH's in vapor state mixtures; and (7) initiated the application of LSF to measurements of CN. 15 references, 7 figures, 1 table.

22963 **(N—85-10065) Comparison of numerical techniques for integration of stiff ordinary differential equations arising in combustion chemistry.** Radhakrishnan, K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1984. 41p. (NASA-TP—2372; E—2149). NTIS, PC A03/MF A01.

The efficiency and accuracy of several algorithms recently developed for the efficient numerical integration of stiff ordinary differential equations are compared. The methods examned include two general-purpose codes, EPISODE and LSODE, and three codes (CHEMEQ, CREK1D, and GCKP84) developed specifically to integrate chemical kinetic rate equations. The codes are applied to two test problems drawn from combustion kinetics. The comparisons show that LSODE is the fastest code currently available for the integration of combustion kinetic rate equations. An important finding is that an interactive solution of the algebraic energy conservation equation to compute the temperature does not result in significant errors. In addition, this method is more efficient than evaluating the temperature by integrating its time derivative. Significant reductions in computational work are realized by updating the rate constants (k at(supra N) N exp(-E/RT) only when the temperature change exceeds an amount delta T that is problem dependent. An approximate expression for the automatic evaluation of delta T is derived and is shown to result in increased efficiency.

22964 **(ORNL/TM—9571) Chemical and physical characterization of phosphorus smokes for inhalation exposure and toxicology studies. Final report.** Ramsey, R.S.; Moneyhun, J.H.; Holmberg, R.W. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010210.

The chemical and physical properties of the aerosols produced from the combustion of red phosphorus containing butyl rubber (RPBR) and white phosphorus impregnated in felt (WPF) have been examined. The aerosols were produced at a uniform concentration by extruding softened raw material and burning the emerging filament or by igniting fragments of the formulations in a convective air flow. Aeorsol particle sizes were found to be within the respirable range, varying from 0.4 to 1.0 micrometers depending upon generation conditions and aerosol age at collection. Chemically, both RPBR and WPF aerosols were found to be very similar, composed primarily of water and phosphoric acids. Organic compounds and inorganic gases were detected only at trace levels. 11 references, 15 figures, 11 tables.

22965 **(PB—85-146223/XAB) Study of HTPB-based SOFRAM fuels.** Eliasson, R. (Foersvarets Forskningsanstalt, Sundbyberg (Sweden)). Nov 1984. 54p. (In Swedish). (FOA-C—20563-D3). NTIS, PC E04/MF E01.

In a small Solid Fuel Ramjet (SOFRAM), test-engine burning rate and combustion efficiency for different HTPB-based fuels were studied. Tubular fuel charges with an external diameter of 72 mm were used. Ram air temperature and chamber pressure simulating different flight conditions were varied as well as chamber geometry. It was found that additives of aluminium (30 %), magnesium (30 %) or ammonium perchlorate, AP, (10-30 %) to HTPB increase the burning rate. However high content of AP or addition of iron oxide (1 %) seems to increase the risk for pressure oscillations. Addition of carbon black (5 %) to HTPB decreases the burning rate. Combustion efficiency increases with chamber pressure or when the air flow through the engine increases at constant ram air temperature and constant chamber pressure. The burning rate was in good agreement with previous results from a larger size SOFRAM engine.

22966 **Shocked states from initially liquid oxygen—nitrogen systems.** Schott, G.L.; Shaw, M.S.; Johnson, J.D. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **82**: No. 9, 4264-4275(1 May 1985).

Sets of pressures and their corresponding specific volumes and internal energies are derived from measurements on steadily propagating, planar shock waves propelled by explosively driven metal assemblies into a 1:1 atomic mixture of the elements nitrogen and oxygen in each of two liquid initial states. One of these is the equimolar solution of O_2 and N_2, at T≅85 K, v_0≅1.06 cm^3/g; the other is the pure explosive compound NO, at T≅122 K, v_0≅0.79 cm^3/g. Results for this system are calculated with effective spherical potentials and presented graphically for comparison with the measurements. Single- and reflected-shock states are reported, as are incidental new results on pure liquid N_2 at 85 K. The method of measurement is described, with reference to its previous applications to liquid O_2 and Ar. First-shock pressures from both initial forms lie between 10 and 30 GPa, and the Hugoniots intersect at a common state, near 21 GPa, where a single reflected-shock Hugoniot is centered. Concordant measured state variables at this intersection provide novel confirmation of the expectation, inherently incorporated into theory, that unique equilibrium states are reached. Accounting for densities of these states by theory indicates a significant amount of oxidized nitrogen, in reversible equilibrium with major, but not exclusive, N_2 and O_2 components. This is treated as residual NO only, although the uncertainty in the potentials for other oxides does not assure their absence.

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4201 General Engineering

22967 **(SAND—83-2377C-Rev.) Manufacturing technology update - SNLA. Revision.** Walter, J.K.S. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 16p. (CONF-8410151—1-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002004.

From JOWOG 39 meeting; Aldermaston, UK (10 Oct 1984).

The text of a speech and accompanying viewgraphs are given which review Sandia Laboratories' basic assignments in the US DOE weapons program, discuss some of the highlights of

changes in the Sandia organization, and touch on Sandia's interest in manufacturing technology both as an incidental factor in accomplishing hardware goals and in areas where manufacturing technology is a primary organizational interest. (LEW)

22968 **(UCID—20364) Micro-CAE mechanical engineering software development.** Comfort, W. III; Davis, B. (Lawrence Livermore National Lab., CA (USA); Northern Arizona Univ., Flagstaff (USA)). 8 Feb 1985. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008880.

A concept in Microcomputer-Aided Engineering has been evolving and maturing at Lawrence Livermore National Laboratory during the past 4 years. In harmony with the goals of the project, several universities are participating in the development of software which will be useful both to engineering colleges and to practicing engineers. Among the universities who have had faculty participants in this project are University of California (Berkeley), University of Arkansas, Oregon State University, University of California (Santa Barbara), and Northern Arizona University. The goals of the project are that of developing, collecting, and/or converting approximately 40 software packages, and transfering Micro-CAE technology/software to universities. Micro-CAE is defined as the use of special purpose microcomputer graphics-augmented software, invoked for the purpose of aiding engineers in modeling physical events and designing systems. The software is further characterized by user-system interactiveness, high degree of system friendliness, and heavy dependence on automatic graphics interpretation. The software will be made available to any university for instructional purposes at a cost of no more than what it costs to reproduce the diskettes and documentation. Approximately one-third of the software is now available, including: REFRIF - A vapor-compression refrigeration modeling program, SPRING - A spring design program, RANKINE - A steam power cycle modeling program, VIBMAIN - A one-degree of freedom vibration modeling program, SHAFT - A stepped-shaft design/modeling program, BEARING - An oil-cooled bearing design program, DELAWARE - A tube-in-shell heat exchanger program, DOUPIPE - A double-pipe heat exchanger program, MECHAN - A kinetic/kinematic mechanisms program, INOUT - Interactive input/output routines, KERNEL80 - Graphics primitive, and TRIX - A line editor and word processor. The software will be made available to run under CP/M and MS-DOS operating systems.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 42020022336, 22412, 22450, 23172

22969 **(BDX—613-3176) Conversion of hydraulic control system software to PL/M. Final report.** Litle, P.D. (Bendix Corp., Kansas City, MO (USA)). Apr 1985. Contract AC04-76DP00613. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009849.

Existing software developed for use on the Bendix prototype hydraulic control system has been converted to a higher-level language - programming language/microprocessors (PL-M) - to reflect changes made to the production version hardware. PL/M was chosen to replace assembly language because it is easier to maintain than assembly code, and program modules written for the Bendix mold heating and cooling control system could be incorporated. Several improvements to the prototype software were judged vital to the usefulness of the controller. The production version of the controller software features a more user-friendly operating system than the prototype and an enhanced ability to perform pressure and velocity ramping. The new software has been tested and debugged using an ICE85 in-circuit emulator and a simulator built to simulate the digital inputs and outputs of the control system. The ICE85 emulator allowed down-loading of software to a target system for execution and debugging at 80% of real-time speed. This allowed initial debugging to be done without any field hardware. Software was checked as much as possible and had no apparent malfunction or bugs.

22970 (DOE/ER/10275—1B, pp 48) **Pre-fermian reactor.** Sorrell, S. (Iowa State Univ., Ames). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

22971 **(EEC—154) Non-linear dynamic analysis of noncontacting coned-face mechanical seals.** Green, I.; Etsion, I. (Technion-Israel Inst. of Tech., Haifa. Dept. of Mechanical Engineering). Aug 1984. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85900588.

The complete non-linear equations of motion of a flexibly mounted stator in a non-contacting coned-face mechanical seal are solved numerically. The solution utilizes a transient dynamic analysis and takes into account rotor axial runout and assembly tolerances in the form of initial stator misalignment. Cavitation of the fluid film is also accounted for. A parametric investigation is performed and the effect of various design parameters and operation conditions on the seal dynamics is presented and discussed. A critical shaft speed is found above which the seal becomes dynamically unstable. A critical rotor runout is found which, if exceeded, will cause seal failure due to local face rubbing contact. A comparison is made between the numerical results and those of a simpler analytical solution. It is found that the analytical solution is valid for most practical applications of mechanical seals. 8 references, 11 figures, 1 table.

22972 **(EGG-M—25184) Automated expertise accumulation for valve selection.** Crandall, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). [1982]. Contract AC07-76ID01570. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008935.

Many experimental systems designed for energy research and development require the control of fluid flows. Selecting the appropriate valves for such systems is complicated not only by the uniqueness of the systems designed, but also by the availability of a variety of specialized valves from a multitude of valve manufacturers. Individuals in large mechanical engineering organizations that design these experimental systems require comprehensive expert knowledge of valve selection but possess only limited portions of this experience based knowledge. Even though these organizations have the expertise among their engineers, it is not consistently available to the right individual at the time of design. Expert systems (programs that solve problems by logical inference based on a store of knowledge) may eventually improve valve selection in mechanical design firms, but only if the problem of extracting and accumulating the expertise in the organization can be solved. This paper describes a computerized prototype titled VALVEFIND designed to accumulate specialized expertise in valve selection, while offering a limited valve selection capability to the user. 5 references.

22973 **(N—85-10843) Conversion of microwave signals by superconducting films in the resistive state.** Yeru, I.I.; Peskovatskiy, S.A.; Sulima, V.S. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1984. 28p. (NASA-TM—77595). NTIS, PC A03/MF A01.

The main characteristics of a superconducting thin film microwave mixer, i.e., conversion efficiency and bandwidth are analyzed. The optimum operating regime of the nonlinear element is determined. Results of calculations are compared with the experimental ones. Experimental data on the noise in the superconducting films in a wide frequency range are presented.

22974 **(PB—85-141018) Stability and thermal quenches in force-cooled superconducting cables. Final report.** Arp, V.D. (National Bureau of Standards, Washington, DC (USA)). May 1979. 15p. Published in Proceedings of Superconducting MHD Magnet Design Conference, Cambridge, MA, Oct. 18-19, 1978, p 142-156 May 79.

Sponsored by Massachusetts Inst. of Tech., Cambridge. Francis Bitter National Magnet Lab.

This paper describes the active heat transfer and hydrodynamic processes occurring when a cable-in-conduit superconductor

is subjected to a localized, time dependent, thermal perturbation. The coupled partial differential equations describing the superconductor temperature and the helium pressure, temperature, and flow are integrated numerically for several practical geometries. The program can be used to predict both the stability limit and the subsequent quench behavior of the system. Comparison with existing multiple-stability data suggests that the predictions are close but further refinements in the heat transfer parameterization are necessary. Predicted quench behavior will be tested in experiments planned for late 1980.

22975 **(PB—85-147155/XAB) Superconducting quantum current standard.** Gallop, J.C.; Radcliffe, W.J. (National Physical Lab., Teddington (UK). Div. of Quantum Metrology). [1984]. 14p. (NPL-QU—67). NTIS, PC E03/MF E03.

The purpose of this paper is to suggest the possibility that if macroscopic quantum tunnelling can be observed, then a new quantum current standard may be attainable, analogous to the Josephson voltage standard, and accessible via a measurement of the charge on the electron.

22976 **(PB—85-150530/XAB) Massive copper nuclear demagnetization stage for refrigeration of liquid ^{3}He.** Pekola, J.P.; Simola, J.T.; Nummila, K.K. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). Sep 1984. 14p. (TKK-F-A—556). NTIS, PC E03/MF E01.

A nuclear stage consisting of 35 mol of massive copper was constructed for superfluid ^{3}He research in a rotating cryostat. Slits, 1.5 mm apart, were cut along the long axis of the copper rod to reduce eddy-current heating. The new nuclear stage is superior compared to the wire bundle used earlier. The ultimate heat leak is only 0.5 nW which allows a few weeks continuous measurements in the superfluid phases. In the first runs the initial heat leak was about 500 nW, but after removing the unannealed support parts of copper, the starting level was reduced to about 70 nW. The ultimate low heat leak is reached in 2 - 3 weeks after cooling to liquid helium temperatures.

22977 **(PNL-SA—12626) MCC-15: waste/canister accident testing and analysis method.** Slate, S.C.; Pulsipher, B.A.; Scott, P.A. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 15p. (CONF-850314—37). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009128.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The Materials Characterization Center (MCC) at the Pacific Northwest Laboratory (PNL) is developing standard tests to characterize the performance of nuclear waste forms under normal and accident conditions. As part of this effort, the MCC is developing MCC-15, Waste/Canister Accident Testing and Analysis. MCC-15 is used to test canisters containing simulated waste forms to provide data on the effects of accidental impacts on the waste form particle size and on canister integrity. The data is used to support the design of transportation and handling equipment and to demonstrate compliance with repository waste acceptance specifications. This paper reviews the requirements that led to the development of MCC-15, describes the test method itself, and presents some early results from tests on canisters representative of those proposed for the Defense Waste Processing Facility (DWPF). 13 references, 6 figures.

22978 **(RFP—3694) Remote engineering progress report, January-December 1983.** Brown, C.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 22 Feb 1985. Contract AC04-76DP03533. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008905.

Progress in the Remote Engineering group's work at Rocky Flats from January to December 1983 is summarized. Remote Engineering's goals in all 1983 projects were to help increase production capacity and reduce radiation exposure by converting hands-on operations to remote operations. Seventeen separate projects were handled by Remote Engineering in 1983. Four of the projects automate related operations in Building 559, the Chemical Analytical Laboratory. In Building 559, the following operations needed mechanizing: Plutonium Oxide Pelletizing; Sample Cutting; Storage, Transfer, and Retrieval; and Emission Spectrometer. The majority of Remote Engineering's work concerned remoting diverse systems for production application. These systems included the Molten Salt Button Breakout Operation, Part Serialization processes for three buildings, Radiography, Americium Recovery, Photosensitive Liquid Coating Device, Part Brushing, Plutonium Oxide/Skull Burn and Reburn, the W-79 Remote Assembly Machine, Site Return Compactor, Filter Probe Positioner, and a Unimate Robot to replace the obsolete robot in the Building 883 Forging operation. The group provided mechanical engineering support to the 371 Task Team, and at the request of Lawrence Livermore Laboratory, the group evaluated an automated assembly for a Mechanical Safe and Arm Detonator (MSAD). Three of the projects were completed during the year including the Site Return Compactor, Photosensitive Liquid Coating Device and the MSAD demonstration. Two other systems are in production but still undergoing development: the W-79 Assembler and the PuO_2 Pelletizer. Three systems have been designed and fabricated and await final installation: the Emission Spectrometer Automation, the Filter Probe Positioner, and the Unimate Robot Replacement. The other projects are at various stages of design and development.

22979 **(SAND—84-1823C) Measurement of release fraction of contents for TRUPACT-I subjected to normal transport and accident conditions.** Sandoval, R.P.; Warrant, M.M.; Apple, M. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-850314—34). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009334.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

A series of full-scale experiments were conducted to characterize the release of simulated waste from waste containers packaged in a Transuranic Package Transporter (TRUPACT) subjected to a series of drop, puncture, and thermal environments. The measurement techniques and procedures used in this study to characterize and quantify the release of airborne and non-airborne waste material from the secondary containers to the TRUPACT-I cavity are described. 7 references, 3 figures, 2 tables.

22980 **(SAND—84-1855C) Structural code benchmarking for the analysis of impact response of nuclear material shipping casks.** Glass, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008236.

The Transportation Technology Center at Sandia National Laboratories has initiated a program to benchmark thermal and structural codes that are available to the nuclear material transportation community. The program consists of the following five phases: (1) code inventory and review, (2) development of a cask-like set of problems, (3) multiple independent numerical analyses of the problems, (4) transfer of information, and (5) performance of experiments to obtain data for comparison with the numerical analyses. This paper will summarize the results obtained by the independent numerical analyses. The analyses indicate the variability that can be expected both due to differences in user-controlled parameters and from code-to-code differences. The results show that in purely elastic analyses, differences can be attributed to user controlled parameters. Model problems involving elastic/plastic material behavior and large deformations, however, have greater variability with significant differences reported for implicit and explicit integration schemes in finite element programs. This variability demonstrates the need to obtain experimental data to properly benchmark codes utilizing elastic/plastic material models and large deformation capability.

22981 **(UCID—20366-85) Engineering Technology Base Thrust Areas.** McDonald, H.C. (Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009498.

Efforts in the following areas are briefly summarized: diagnostics and microelectronics engineering, signals and control engineering, microwave and pulsed power engineering, computer-aided engineering in both electronics and mechanical engineering, engi-

neering modeling and simulation, systems engineering, fabrication technology, non-destructive evaluation, and dynamic systems and controls. (LEW)

22982 **(UCRL—92272) Fabrication criteria for shipping containers used to transport radioactive materials.** Fischer, L.E. (Lawrence Livermore National Lab., CA (USA)). 1 Mar 1985. Contract W-7405-ENG-48. 11p. (CONF-850314—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008971.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Criteria are identified for controlling the fabrication of metal components of shipping containers used for transporting radioactive materials. The criteria have been selected from the ASME Code and are based on the level of radioactive materials being transported and the nuclear safety function of the container's components. Criteria are identified for fabrication processes which are related to materials control, forming, heat treatment, examination and acceptance testing. Implementation of criteria will ensure the structural integrity of shipping containers at levels consistent with the radioactive materials being transported. 10 references, 1 table.

22983 **(UVA-ER—966-85/U) Influence of material creep on rotor dynamics .** Crandall, S.H. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1985. Contract AC05-76OR01779. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008545.

A simplified model of a single whirling mode was used to show that slow rotor creep has a slight destabilizing effect on forward whirls when the rotor rotates supercritically and that the amplitude of the forced synchronous whirl can grow without limit under steady rotation at certain subcritical rotation rates. An elastic rotor system is described. A standard three-element viscoelastic model and a power-law creep model were studied. Results for the two creep models are compared. The long-time effects of creep may be interpreted as causing a wandering unbalance.

22984 **Gas phase reactions of iron clusters with hydrogen. I. Kinetics.** Richtsmeier, S.C.; Parks, E.K.; Liu, K.; Pobo, L.G.; Riley, S.J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **82**: No. 8, 3659-3665(15 Apr 1985). Contract W-31-109-ENG-38.

The kinetics of the gas phase reactions of hydrogen and deuterium with iron clusters in the range Fe_8 to Fe_{68} have been investigated. It is found that reaction rate constants are a strong function of cluster size, varying by more than five orders of magnitude in this size range. The largest rate constants correspond to approximately 3% of a hard sphere cross section. Abrupt changes in the rate constant from one cluster to the next are seen. Qualitative temperature dependencies of cluster reactivity have been determined. The more reactive clusters show decreased reactivity with increased tempeature, while the least reactive clusters become more reactive. Strong isotope effects are seen only in the Fe_{10} to Fe_{14} size range. Mechanisms for the reactions of H_2 and D_2 with iron clusters are discussed in light of these observations.

4203 Lasers

REFER ALSO TO CITATION(S) 42030022532, 23013, 23022, 23023, 23024, 23025, 23026, 23027, 23141, 23348

22985 **(AD-A—148951/7/XAB) Two-stage free-electron laser research. Annual summary report, 1 October 1983-30 September 1984.** Segall, S.B. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 24 Oct 1984. 30p. (KMSF-U—1526). NTIS, PC A03/MF A01.

KMS Fusion, Inc. began studying the feasibility of two-stage free electron lasers for the Office of Naval Research in June, 1980. At that time, the two-stage FEL was only a concept that had been proposed by Luis Elias. The range of parameters over which such a laser could be successfully operated, attainable power output, and constraints on laser operation were not known. The primary reason for supporting this research at that time was that it had the potential for producing short-wavelength radiation using a relatively low-voltage electron beam. One advantage of a low-voltage two-stage FEL would be that shielding requirements would be greatly reduced compared with single-stage short-wavelength FEL's. If the electron energy were kept below about 10 MeV, x-rays, generated by electrons striking the beam line wall, would not excite neutron resonance in atomic nuclei. These resonances cause the emission of neutrons with subsequent induced radioactivity. Therefore, above about 10 MeV, a meter or more of concrete shielding is required for the system, whereas below 10 MeV, a few millimeters of lead would be adequate.

22986 **(AD-A—149024/2/XAB) Axial velocity spread acceptance of free-electron lasers. Scientific report, 15 June 1982-14 June 1984.** Gover, A.; Jerby, E. (Tel Aviv Univ. (Israel). Quantum Electronics Lab.). 24 Jul 1984. 28p. NTIS, PC A03/MF A01.

Various criteria are presented for the definition of axial velocity spread acceptance of free-electron lasers (FEL), and provide analytical approximations, numerical calculations and design curves for this parameter in the low, high, and intermediate gain regimes. This parameter is used to calculate the energy spread acceptance, emittance acceptance, and other e-beam quality parameters. A special emphasis is put on the design considerations of short-wavelength (x-ray) FELs. For this reason, the parameters calculation in this work is limited to the tenuous beam regimes only, and parameters are calculated for intermediate and moderately high gain regimes, which correspond to the low quality factor of x-ray resonators in the present state of the art.

22987 **(AD-A—149052/3/XAB) Free-electron laser with a rotating quadrupole wiggler. Memorandum report, October 1983-September 1984.** Levush, B.; Antonsen, T.M.; Manheimer, W.M.; Sprangle, P. (Naval Research Lab., Washington, DC (USA)). 31 Dec 1984. 38p. (NRL-MR—5471). NTIS, PC A03/MF A01.

A new rotating quadrupole wiggler configuration for free-electron lasers is proposed. The stability analyses of the particles trajectories in a continuously rotating quadrupole magnetic field and self-fields of a solid beam is performed. The resulting orbit equations are solved exactly and it is shown that high-current beams can be confined. To analyze the potential of this wiggler for free-electron lasers, a set of nonlinear orbit equations is derived which average over the fast time variation in both the wiggler and radiation fields. By integrating these equations, the linearized single particle gain of the free electron laser is calculated. It is shown that at comparable wiggler strengths, the rotating quadrupole wiggler and conventional wiggler give similar gains.

22988 **(AD-A—149113/3/XAB) Bibliography of Soviet laser developments, Number 66, July-August 1983.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). Sep 1984. 141p. (DIA-DST—2700Z-004-84). NTIS, PC A07/MF A01.

This bibliography is the 66th in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical laser; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy, beam-target interaction, and plasma generation and diagnostics.

22989 **(DOE/AL/10732—T1) Definition of requirements for injection locking of pulsed uv lasers. Final report.** (Spectra Technology, Inc., Bellevue, WA (USA)). 11 Apr 1985. Contract AC04-79AL10732. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010126.

The purpose of this program was a demonstration that successful beam quality control of LIS-scale rare gas halide lasers could be achieved with relatively low power injection sources. This is particularly important when one considers that high repetition rates are required in the LIS system. At the outset of this pro-

gram, Spectra Technology, Inc. was involved in the development of a series of very high repetition rate, but relatively low energy lasers using a unique compact flow loop geometry. These devices (which are known commercially under the name Exci-Lite) are compact and quite inexpensive. If it could be shown that lasers of this type are suitable as injection sources for much higher power LIS lasers, then injection locking could be incorporated into the LIS system with minimal impact. The impact of this demonstration on overall LIS system design was sufficient to warrant a direct demonstration. This program was divided into two parts. The first was a demonstration of the energy scaling which could be achieved in injection locking. An Exci-Lite scale RgH laser was used to inject a single pulse XeCl laser which was similar in dimensions and single pulse energy to proposed LIS devices. Detailed descriptions of these two experimental tasks form the contents of the remaining two sections of this report.

22990 (LBL—18945, pp 49-51) **Single-pass FEL experiments at LLNL.** Prosnitz, D. (Lawrence Livermore National Lab., CA). Dec 1984. NTIS, PC A04/MF A01. File Number DE85009968.

In Coherent x-rays and vacuum-ultraviolet radiation from storage-ring-based undulators and free electron lasers.

Under certain conditions, the FEL interaction generates enough gain to produce significant amounts of radiation with only a single pass of the electron beam through the wiggler. This occurs if the electron beam has a very high phase-space density (brightness). Furthermore, if the wiggler can be made sufficiently long, the amplifier can be made to saturate on its own noise. The length of the wiggler is limited by diffraction of the optical beam, which eventually reduces the FEL gain. However, refractive phenomena have been predicted that will greatly reduce the detrimental effects of diffraction. A high-current electron beam is required to demonstrate refractive guiding in an FEL. To date there are no electron beams bright enough to drive a far-ultraviolet FEL. However, the required electron-beam brightness is greatly reduced at longer wavelengths. We have taken advantage of this scaling to build a microwave FEL that demonstrates high (exponential) single-pass gain. This experimental facility [the Electron Laser Facility (ELF) at Lawrence Livermore National Laboratory] allows us to verify our models of FEL operation and confirm that very high gain can be obtained. 3 references, 1 figure.

22991 (LBL—18945, pp 53-58) **Self-amplified spontaneous emission.** Pellegrini, C. (Brookhaven National Lab., Upton, NY). Dec 1984. NTIS, PC A04/MF A01. File Number DE85009968.

In Coherent x-rays and vacuum-ultraviolet radiation from storage-ring-based undulators and free electron lasers.

The self-amplified spontaneous-emission mode of operation of a free electron laser (FEL) is based on a remarkable property of the undulator/electron-beam radiation system: when the radiation field is small or zero, there is a range of parameters for which the system is collectively unstable. This collective instability leads to an exponential growth of the radiation field and of the beam bunching at the radiation wavelength, until the system saturates. This offers the possibility of operating an FEL in a configuration in which the electron beam is simply sent through the undulator; the noise current present in the electron beam is enough to start the exponential growth and, given the right beam and undulator parameters, to produce at the undulator exit a large amount of coherent radiation. We call this mode of operating an FEL self-amplified spontaneous emission. 4 references, 2 figures.

22992 (PB—85-147650/XAB) **Generation of brief luminous pulses from laser diodes.** Pocholle, J.P.; Raffy, J.; Thedrez, B.; Papuchon, M.; de Cremoux, B. (Thomson-CSF, 75 - Paris (France). Lab. Central de Recherches). 18 Oct 1984. 68p. (In French). NTIS, PC E04/MF E04.

Sponsored by Centre de Documentation de l'Armement, Paris (France). Direction des Recherches, Etudes et Techniques.

The behavior of disconnected laser diodes was studied so as to establish semiconducting sources generating brief luminous pulses, for which purpose we established numerically the conditions on the laser parameters which had to be met in order to obtain pulses. A polarization current couple, modulation current amplitude for the modulation frequency and a cavity length make it possible to obtain a pulse mode easily. Luminous pulses presenting a half-height size of 40 pS could be reached at a modulation frequency on the order of the GHz. The assembly allowing for such pulses is relatively simple as it suffices to have a radiofrequency generator and a current source for source prepolarization. To obtain shorter pulses, an external cavity was used to allow the development of an active coupling mechanism between the cavity modes. The study of the optical power emitted demonstrated the effect of the external cavity on diode behavior.

22993 **Gain and absorption measurements of electron beam pumped, high Kr concentration KrF gas mixtures.** Salesky, E.T.; Kimura, W.D. (Los Alamos National Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **46**: No. 10, 927-929(15 May 1985).

Gain and out-of-band absorption measurements are made of electron beam pumped KrF laser mixtures (Ar diluent) with 4—99.6% Kr concentrations. The average pump rate is maintained at roughly-equal120 kW/cm^3 by adjusting the total pressure of the mixtures to compensate for the different electron stopping powers of Ar and Kr. The F_2 number density is also kept constant at 8.9 x 10^{16} cm^{-3}. Measured small-signal gains (g_0-α) are 3.8%/cm at 4% Kr, 3.3%/cm at 50% Kr, and 3.2%/cm at 99.6% Kr. The out-of-band absorptions (261 nm) are 0.43%/cm at 4% Kr, 0.74%/cm at 50% Kr, and 0.87%/cm at 99.6% Kr. Our computer model agrees with the results and predicts in-band absorptions (248 nm) of 0.29%/cm at 4% Kr, 0.44%/cm at 50% Kr, and 0.52%/cm at 99.6% Kr.

22994 **Visible and ultraviolet radiation generation using a gas-loaded free-electron laser.** Fauchet, A.M.; Feinstein, J.; Gover, A.; Pantell, R.H. (National Synchrotron Light Source, Brookhaven National Laboratory, Brookhaven, NY 11793). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **QE-20**: No. 12, 1332-1341(Dec 1984).

Gas loading of a free-electron laser modifies the phasematching condition while the small-signal gain expression remains the same when written in appropriate form. This permits a wider parameter space than the vacuum FEL, which is particularly advantageous at shorter wavelength operation. Scattering of the electrons by the gas limits the interation length, but available gains are still high enough to allow oscillation build-up. For example, a 0.5 μm wavelength helical wiggler FEL utilizing a 41 MeV electron beam is restricted to a length of 14 cm, has a small signal gain of 21 percent, and builds up to saturation in less than 1 μs. Tunability of this device over several microns is easily obtained by changing the gas pressure.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 42040022407, 22756

22995 **Combined convection and radiation in rectangular ducts.** Im, K.H.; Ahluwalia, R.K. (Argonne National Lab., Argonne, IL). *International Journal of Heat and Mass Transfer;* **27**: No. 2, 221-231(Feb 1984).

Combined convective and radiative heat transfer in rectangular ducts is analyzed by solving simultaneously the fluid dynamic equations and the radiation transport equation. The major approximations invoked in the analysis are the assumption of parabolic flow for the fluid equations and the use of the moment method for simplifying the radiation transport equation. The analysis is applicable to general compressible, turbulent, developing, radiating flow in rectangular ducts in the presence of scattering particles. In the sample calculations, Mie theory is used for determining the spectral absorption and scattering coefficients of the particles.

4205 Materials Testing

REFER ALSO TO CITATION(S) 42050022845

22996 **(UCID—20379) Dynamic test and model verification of Cottage device canister.** Weaver, H.J.; Burdick, R.B.; Abe, M.C. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009951.

This paper discusses work done on the Cottage device canister. A dynamic test was performed on the structure while it was suspended from a Ringer Crane inside the construction tower at the Nevada test Site. Upon completion of the modal test, comparisons were made to the results of a finite element analysis done on the same structural system. By coupling these two methods of determining a structures dynamic characteristics a better understanding of the response of the device canister can be gained.

22997 **(UCRL—92271) Radiation interactions for tomography.** Zolnay, A.S. (Lawrence Livermore National Lab., CA (USA)). 6 Mar 1985. Contract W-7405-ENG-48. 11p. (CONF-8503121—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008961.

From American Society of Nondestructive Testing spring conference; Washington, DC, USA (11 Mar 1985).

There are some very exciting potentials in the development of tomographic systems. Success in attaining these potentials involves a sophisticated application of the fundamental physics principles governing radiation interactions.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 42080022520, 22532, 22637, 22981, 23039, 23040

22998 **(AD-A—148775/0/XAB) PNPN latchup in bipolar LSI devices. Final report, 1 January 1980-1 October 1981.** Pease, R.L.; Alexander, D.R. (Mission Research Corp., Albuquerque, NM (USA)). 1 Jan 1982. 95p. NTIS, PC A05/MF A01.

PNPN latchup was studied both analytically and experimentally in several bipolar LSI technologies including integrated injection logic (I to the second power L), integrated Schottky logic (ISL), Schottky Transistor logic (STL) and emitter coupled logic (ECL). The latchup analysis procedure was expanded and applied to LSI microcircuits representing each of the technologies. This procedure consists of a) the identification of parasitic PNPN paths, b) the electrical characterization of the paths, c) detailed circuit analysis, and d) determination of worst case bias conditions for radiation testing. The identification was performed from chip photomicrographs and composite mask drawings. The characterization was performed experimentally by measuring parasitic transistor gains and SCR parameters on decoupled paths and analytically by using a semiconductor device physics code (PN code) in conjunction with doping profiles. The detailed circuit analysis was performed either by hand or with the circuit analysis code SPICE. Radiation testing was performed at the White Sands Missile Range LINAC facility. The results of the study were, a) latchup cannot occur in non-isolated I to the second power L, b) latchup cannot occur in the internal logic of ISL or STL without causing a problem with electrical performance, c) no latchable paths were found by analysis in the 93471 ECL 4kK RAM, the I/0 buffers on a ISL/STL gate array or the I to the second power L peripherals of the 9408 I to the 3rd power L microprogram sequencer.

22999 (DOE/ER/10275—1B, pp 39) **Microcomputer-multichannel analyzer connection.** Swift, G.M. (Univ. of Illinois, Urbana). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23000 **(EGG—1183-1226) Equalizer handbook.** Hendricks, T. (EG and G Idaho, Inc., Idaho Falls (USA)). 15 Apr 1966. Contract AC08-83NV10282. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009042.

Response equalization is a method for obtaining improved data in fast transient diagnostic system. This handbook has been prepared to provide a practical knowledge of the properties and uses of response equalization to the physicist, mathematician, engineer and technician, whether or not he possesses analysis and synthesis knowledge considered essential to understanding of equalization techniques. The organization and content are based upon lectures given at various weapons test laboratories. In Section 2 and 3, only the simplest response information is considered to establish definitions used in the handbook. Section 4 presents design techniques for obtaining specific desired equalizations. Sections 5 and 6 contain information useful for estimating characteristics of the equalized system. Section 7 describes a method by which one may, with some limitations, mathematically equalize data without using an actual circuit.

23001 **(SAND—84-2420) Technique for measuring the effective source reflection coefficient of two-resistor power splitters.** Moyer, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009964.

Three different methods for measuring the effective source reflection coefficient of two-resistor power splitters have been described. Arguments have been made, and data presented showing that one of these, the Active Open-Circuit method, produces measured values with smaller uncertainty than the other two.

23002 **(UCID—20372) Electrical line source and point source interactions with anomalies in the ground.** Lytle, R.J.; Beatty, J.A. (Lawrence Livermore National Lab., CA (USA)). Dec 1984. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009777.

Illustrative examples show that line source electrode interactions with a cylindrical anomaly can serve as an adequate qualitative model for point source electrode interactions with cylindrical and spherical anomalies. Subject to certain restrictions, the quantitative results for point and line source interactions with cylindrical anomalies can even be approximately the same. This is of benefit, due to the simplicity of the line source mathematical representation, in being able to determine the utility of means for sensing various anomalies within the ground.

23003 **Computational model of exploding metallic fuses for multimegajoule switching.** Lindemuth, I.R.; Brownell, J.H.; Greene, A.E.; Nickel, G.H.; Oliphant, T.A.; Weiss, D.L. (Thermonuclear Applications Group, Applied Theoretical Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **57**: No. 9, 4447-4460(1 May 1985).

A new model for determining the time-dependent behavior of exploding metallic fuses is formulated. The model draws on an atomic data base and gives insight into the temporal behavior of the material density and temperature of the fuse as well as the nonlinear electrical circuit interaction. The model includes an embedding insulating tamper and leads to a plausible explanation of fuse "restrike." The model predicts time-scale compression of 500 for inductive store systems powered by explosive driven magnetic flux compression generators. A scenario for achieving multimegajoule foil implosions is predicted.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 42100023006

23004 **(PB—85-143154/XAB) Modifications to FURDEC (furnace heat transfer program) to include self-consistent flame modeling.** Cooper, S. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). [1984]. 46p. NTIS, PC E04/MF E04.

The furnace heat-transfer program FURDEC has been modified to provide the automatic generation of the heat-release distribution. This has been achieved by incorporating simple one-dimensional flame models which are calculated along individual flame paths through the flow field. The model for coal firing calculates the flame heat release consistent with the thermal environment by iterating between flame model and heat-transfer-model calculations. For oil-firing, where combustion is less dependent on chemical kinetics, the flame model calculation precedes the heat transfer computation. This note describes the basic approach to the model formulation and discusses in detail the convergence behavior of the flame model/heat transfer model system.

4220 Underground Engineering

23005 **(LA-UR—85-884) Thermal spallation drilling.** Williams, R.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-850801—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009549.

From International symposium on geothermal energy; Kailua Kona, HI, USA (26 Aug 1985).

Thermal spallation drilling is an underdeveloped process with great potential for reducing the costs of drilling holes and mining shafts and tunnels in most very hard rocks. Industry has used this process to drill blast holes for emplacing explosives and to quarry granite. Some theoretical work has been performed, and many signs point to a great future for this process. The Los Alamos National Laboratory has studied the theory of the spallation process and is conducting experiments to prove out the system and to adapt it for use with a conventional rotary rig. This report describes work that has been accomplished at the Laboratory on the development of thermal spallation drilling and some work that is projected for the future on the system. 3 references, 3 figures.

4240 Pollution Control Equipment

23006 **(PB—85-124642/XAB) Effects of furnace injection of sorbent for SO_2 control on electrostatic precipitator technology and requirements.** Abbott, J.H.; Gooch, J.P.; Kilgore, J.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.; Southern Research Inst., Birmingham, AL (USA)). Nov 1984. 18p. (EPA—600/D-84/276). NTIS, PC A02/MF A01.

Prepared in cooperation with Southern Research Inst., Birmingham, AL.

The paper describes an EPA research program concerning collection of ash/sorbent mixtures. The effects of furnace sorbent injection on the electrical resistivity and the size distribution of particles suspended in flue gas have been measured, using various sorbents and injection modes with a 1 million Btu/hr pilot-scale combustion system. Resistivity was measured both in situ and in the laboratory. It discusses the implication of the results on electrostatic precipitator performance, together with potential corrective measures for improving the collection efficiency of ash/sorbent mixtures.

4250 Power Cycles

23007 **Sensitivity of absorption cycle calculations to fluid property errors calculated stochastically.** Patterson, M.R.; Perez-Blanco, H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1739-1747(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Advanced absorption cycle calculations call for high-temperature property data. There is in most cases an uncertainty associated with those data. This work is focused on determining how those uncertainties influence the reliability of cycle calculations. It is found that in single-effect cycles, relatively large data uncertainties may be tolerated. Double-effect cycles call for relatively small uncertainties for the calculations to be meaningful.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 43010023125

23008 **(AD-A—149247/9/XAB) High-energy pulsed particle accelerator. Final report, 1 August 1983-31 October 1984.** Gilgenbach, R.M. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 31 Oct 1984. 7p. NTIS, PC A02/MF A01.

This project was performed under the DoD University Instrumentation Program. A state-of-the-art accelerator was designed, constructed, and tested with the following parameters: output (working) voltage: 1 megavolt; pulselength: adjustable to 1 microsecond from 0.1 microsecond; output energy: at least 10 kJoules in 1 microsecond within voltage flatness; current: at least 10 kA into fixed resistance 100-ohm load; voltage deviation from flattop: predicted to be less than + or - 7% voltage fluctuation into variable diode impedance which decreases from 300 ohms to 50 ohms during the 1 microsecond pulse (less than + or - 5% total voltage deviation into fixed resistance load of 100 ohms). Unique circuitry was included in the generator to permit electrical compensation for diode impedance drop.

23009 **(LA-UR—85-882) Accelerator technology working group summary.** Jameson, R.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 12p. (CONF-850128—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009547.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

A summary is presented of workshop deliberations on basic scaling, the economic viability of laser drive power for HEP accelerators, the availability of electron beam injectors for near-term experiments, and a few very general remarks on technology issues.

4302 Beam Dynamics, Field Calculations, And Ion Optics

23010 **(AD-A—148071/4/XAB) Beam-propagation study: stabilization of the resistive hose instability in intense electron beams. Final report, 1 July 1983-30 April 1984.** Adler, R.J.; Kiuttu, G.F.; Richter-Sand, R.J. (Mission Research Corp., Albuquerque, NM (USA)). Aug 1984. 46p. NTIS, PC A03/MF A01.

A series of experiments has been performed to investigate the effect of unidirectional beam particle rotation on the resistive hose instability. Using the 4 MV, 100 kA, IBEX accelerator in a foil diode configuration, hose growth for hollow, partially hollow, and non-rotating Bennett profile beams was investigated. It was found that partially hollow, rotating beams were most stable. In particular, they were more stable than non-rotating Bennett profile beams both in terms of the growth rate in per cm and in the growth per betatron wavelength. The observed reduction in instability growth rate per betatron wavelength over Bennett profile beams was a factor of 2.5. Stable propagation for >6 betation wavelength (the full experiment length) was observed in some shots where the beam was well aligned. Broadened return-current profiles and long plasma decay times were also observed, consistent with our present understanding of high current mode propagation.

23011 **(AD-A—148106/8/XAB) Nonlinear transverse-electron-beam dynamics in a modified betatron accelerator. Memorandum report.** Kapetanakos, C.A.; Marsh, S.J. (Naval Research Lab., Washington, DC (USA)). 30 Nov 1984. 47p. (NRL-MR—5387). NTIS, PC A03/MF A01.

The transverse-electron-beam dynamics in a modified betatron accelerator is studied using a new approach. This approach is based on the two exact constants of the motion and the potentials at the center of the beam. The main advantage of the present technique is that the ring orbits can be accurately determined over the entire minor cross-section of the torus and not only near the minor

axis. Results indicate that the electron-ring orbits, in the plane transverse to the toroidal magnetic field, always close inside the vacuum chamber and their topology is often substantially different than that predicted from the linear theory.

23012 (LA-UR—85-954) Moment code BEDLAM. Channell, P.J.; Healy, L.M.; Lysenko, W.P. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 3p. (CONF-850504—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009569.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

BEDLAM is a fourth-order moment simulation code. The beam at the input to a linear accelerator is specified as a collection of moments of the phase-space distribution. Then the moment equations, which describe the time evolution of the moments, are numerically integrated. No particles are traced in this approach. The accuracy of the computed distribution, the external forces, and the space-charge forces are computed consistently to a given order. Although BEDLAM includes moments to fourth order only, it could be systematically extended to any order. Another feature of this method is that physically interesting and intuitive quantities, such as beam sizes and rms emittances, are computed directly. This paper describes the status of BEDLAM and presents the results of some tests. We simulated a section of radio-frequency quadrupole (RFQ) linac, neglecting space charge, to test the new code. Agreement with a Particle-In-Cell (PIC) simulation was excellent. We also verified that the fourth-order solution is more accurate than the second-order solution, which indicates the convergence of the method. We believe these results justify the continued development of moment simulation codes.

23013 (LA-UR—85-1021) Free electron laser variable bridge coupler. Spalek, G.; Billen, J.H.; Garcia, J.A.; McMurry, D.E.; Harnsborough, L.D.; Giles, P.M.; Stevens, S.B. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009630.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Los Alamos free-electron laser (FEL) is being modified to test a scheme for recovering most of the power in the residual 20-MeV electron beam by decelerating the microbunches in a linear standing-wave accelerator and using the recovered energy to accelerate new beam. A variable-coupler low-power model that resonantly couples the accelerator and decelerator structures has been built and tested. By mixing the TE_{101} and TE_{102} modes, this device permits continuous variation of the decelerator fields relative to the accelerator fields through a range of 1:1 to 1:2.5. Phase differences between the two structures are kept below 1° and are independent of power-flow direction. The rf power is also fed to the two structures through this coupling device. Measurements were also made on a three-post-loaded variable coupler that is a promising candidate for the same task.

23014 (LBL—19064) Phase and amplitude considerations for the Two-Beam Accelerator. Kuenning, R.W.; Sessler, A.M.; Wurtele, J.S. (Lawrence Berkeley Lab., CA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Feb 1985. Contract AC03-76SF00098. 8p. (CONF-850128—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008455.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

Phase and amplitude considerations are made for a Two-Beam Accelerator and analytic formulas are obtained expressing the phase and amplitude errors in terms of magnetic wiggler errors, beam energy errors, beam current errors, and microwave field amplitude errors. The necessity of phase and amplitude control is shown and schemes are proposed which can accomplish this control.

23015 (SAND—84-2652) Calculations of beam dynamics in Sandia linear electron accelerators, 1984. Poukey, J.W.; Coleman, P.D. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010417.

A number of code and analytic studies were made during 1984 which pertain to the Sandia linear accelerators MABE and RADLAC. In this report the authors summarize the important results of the calculations. New results include a better understanding of gap-induced radial oscillations, leakage currents in a typical MABE gas, emittance growth in a beam passing through a series of gaps, some new diocotron results, and the latest diode simulations for both accelerators. 23 references, 30 figures, 1 table.

23016 (SLAC-CN—291) Sector 1-LTR-RTL-Sector 2 treaty. Woodley, M.D.; Sheppard, J.C. (Stanford Linear Accelerator Center, CA (USA)). 19 Mar 1985. Contract AC03-76SF00515. 2p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008856.

We have determined the location of the linac and damping ring interface. This treaty point serves as a pivot about which the optics for sector one, the Linac-To-Ring lines, Ring-To-Linac lines, and sector two have been designed. The treaty location is at Z = 98.7532 m from the beginning of the SLC linac sector one. Our choices of location and beam parameters are consistent with the verbal charter of Ecklund, Fieguth, and others.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 43030022474, 23031, 23221

23017 (BNL—35985) NSLS infra-red beam line (U3) conceptual design report. Williams, G.P. (Brookhaven National Lab., Upton, NY (USA)). 9 Feb 1984. Contract AC02-76CH00016. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009824.

We describe the conceptual design of an infrared (I-R) beam line on the vacuum-ultra-violet storage ring of the National Synchrotron Light Source. The beam line forms part of the Phase II expansion of the NSLS. Consistent with the implementation of the current design is the extraction of hitherto wasted radiation and the establishment of a mezzanine floor or platform to make full use of the available headroom. This means that the I-R beam line, once established, does not interfere with any existing operations on the VUV floor.

23018 (BNL—51840) NSLS annual report 1984. Klaffky, R.; Thomlinson, W. (eds.). (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 198p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85009877.

The first comprehensive Annual Report of the National Synchrotron Light Source comes at a time of great activity and forward motion for the facility. In the following pages we outline the management changes that have taken place in the past year, the progress that has been made in the commissioning of the x-ray ring and in the enhanced utilization of the uv ring, together with an extensive discussion of the interesting scientific experiments that have been carried out.

23019 (LA-UR—85-854) Los Alamos automated configuration accounting system: a proposal. Cort, G.; Goldstone, J.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-8503119—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009579.

From Softool User's Group meeting; Dallas, TX, USA (25 Mar 1985).

An effective configuration accounting (CA) effort is vital to the success of any software configuration management plan. The CA effort maintains information that details the current status of the software project as well as information that checkpoints the project's history. This information can be used to great advantage by project managers to plan and schedule project activities, to evaluate management strategies, and to serve as a knowledge base for future projects. In this paper, we propose an automated system for managing a modest configuration accounting effort associated with the development and maintenance of a large real-time data acquisition system. For reasons presented in the following sections,

we propose building this system around the Softool Change and Configuration Control (CCC) environment.

23020 **(SLAC-CN—290) Beam tests of phosphorescent screens.** Seeman, J.T.; Luth, V.; Ross, M.; Sheppard, J. (Stanford Linear Accelerator Center, CA (USA)). 5 Mar 1985. Contract AC03-76SF00515. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009843.

Twelve phosphorescent screens were beam tested for linearity, uniformity, low radiation damage and a suitable emitted wavelength for use with television cameras. One screen was chosen for the construction of several intercepting profile monitors which were used during the SLC Ten Sector Tests to measure the emittance and wakefield effects of a damped electron beam.

23021 **(SLAC-CN—293) Alignment labeling scheme for SLC AG magnets, horizontal control points, and tunnel benchmarks.** Oren, W.; Pitthan, R.; Pushor, R.; Ruland, R. (Stanford Linear Accelerator Center, CA (USA)). [1985]. Contract AC03-76SF00515. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009844.

An explanation is given of a system proposed by the survey and alignment group to name magnets and control points in the north and south arcs of the SLC.

4304 Storage Rings

REFER ALSO TO CITATION(S) 43040022990, 22991

23022 **(LBL—18945) Coherent x-rays and vacuum-ultraviolet radiation from storage-ring-based undulators and free electron lasers.** Kim, K.J. (ed.). (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 72p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009968.

High-brightness electron storage rings and permanent-magnet technology provide a basis for the development of coherent radiation in the 10- to 1000-A (xuv) spectral range. The most assured route to the production of coherent x-rays and vuv is the simple interaction between properly constrained relativistic electrons and permanent-magnet undulators, a subject that is already well understood and where technology is well advanced. Other techniques are less well developed, but with increasing degrees of technical challenge they will provide additional coherence properties. Transverse optical klystrons (TOKs) provide an opportunity for additional coherence at certain harmonics of longer-wavelength lasers. Free electron lasers (FELs) extend coherence capabilities substantially through two possible routes: one is the development of suitable mirror coatings. Both FEL techniques would provide vuv radiation and soft x rays with extremely narrow spectral content. Research on all of these techniques (undulators, TOKs, and FELs) is possible in a single facility based on a high-brightness electron storage ring, referred to herein as a Coherent xuv Facility (CXF). Individual items from the report were prepared separately for the data base.

23023 (LBL—18945, pp 1-4) **Introduction: a short-wavelength-FEL/storage-ring complex.** Sessler, A.M. Dec 1984. NTIS, PC A04/MF A01. File Number DE85009968.

In Coherent x-rays and vacuum-ultraviolet radiation from storage-ring-based undulators and free electron lasers.

We believe that, in view of the present state of FEL understanding, it is now proper to construct a research facility devoted to the use of coherent radiation and the advancement of FEL physics technology at wavelengths shorter than 1000 A. We show a possible layout of such a facility, which will be referred to as a Coherent xuv Facility (CXF), where research can be conducted on several techniques for generating coherent radiation. Undulators are already well understood and will generate broadly tunable, spatially coherent radiation of bandwidth $\lambda / \Delta\lambda \approx 10^2$. A crossed undulator system will extend the undulator capability to include variable polarization. For full coherence, in spatial as well as in longitudinal directions, it is necessary to induce and exploit density modulation in electron beams, as is the case in the transverse optical klystrons (TOKs) and FELs. In TOKs, coherent radiation is generated at harmonics of an input laser frequency, with the electron beam playing the role of a nonlinear medium. Ultimately, FELS would deliver intense, tunable x rays and vuv radiation of extremely narrow spectral width. There are two possible routes to an FEL, one based on feedback by end mirrors, the other based on development of a high-gain, single-pass device. It can be seen, from this paper, that the photon flux increases monotonically, or the wavelength decreases monotonically, as one goes through (1) undulator radiation, (2) TOK radiation, (3) FEL oscillator radiation, to (4) FEL single-pass radiation. Each of these will demand considerable quality development effort. Each will result in photon fluxes of increased value to the users.

23024 (LBL—18945, pp 21-39) **Production of Coherent xuv and soft-x-ray light using a transverse optical klystron.** Kincaid, B.M.; Freeman, R.R. (AT and T Bell Laboratories). Dec 1984. NTIS, PC A04/MF A01. File Number DE85009968.

In Coherent x-rays and vacuum-ultraviolet radiation from storge-ring-based undulators and free electron lasers.

This section describes the theory of the production of coherent xuv radiation and soft x rays using a transverse optical klystron (TOK). A TOK uses a high-power laser in conjunction with an undulator magnet to produce laserlike output of xuv radiation from a relativistic electron beam. 16 references, 5 figures.

23025 (LBL—18945, pp 41-48) **FEL operation at CXF: an oscillator configuration.** Colson, W.B. (Berkeley Research Associates, CA). Dec 1984. NTIS, PC A04/MF A01. File Number DE85009968.

In Coherent x-rays and vacuum-ultraviolet radiation from storage-ring-based undulators and free electron lasers.

An important advantage in the design of a new storage-ring free electron laser (FEL) oscillator is the research that has already been done at Orsay, France; the system there has already been made to work near 5000 A. An essential item for the success of the oscillator is the availability of suitable mirror surfaces for the resonant cavity. Recent reports of 60% normal-incidence reflectivity in this wavelength range give us hope. We will assume 50% reflectivity for the evaluation. The goal in an oscillator configuration is to make the gain/pass greater than the loss/pass. Once this is accomplished, long-range coherence is established by mode competition. It is expected that the coherence property of radiation from an FEL oscillator would be superior than that of a high-gain FEL amplifier. The main emphasis of this discussion is a valid estimate of gain, based on feasible storage-ring parameters. 4 references, 3 figures.

23026 (LBL—18945, pp 59-63) **Lattice.** Garren, A.A. Dec 1984. NTIS, PC A04/MF A01. File Number DE85009968.

In Coherent x-rays and vacuum-ultraviolet radiation from storage-ring-based undulators and free electron lasers.

The lattice for Coherent xuv facility is designed to operate in two modes. As a source of radiation from undulators it will be run at 1.3 GeV. Low emittance and long straight sections for the undulators are needed. For free electron laser (FEL) experiments the ring will run at lower energy, 0.5 to 0.75 GeV, and the beam must be of high intensity and have small emittance and energy spread. To have optimum performance for these two modes, tuning flexibility must be assured. In addition, the lattice design must provide adequate spaces for insertion devices, rf, injection and extraction kickers (for the bypass), sextupoles, and orbit-correction equipment. 2 references, 2 figures.

23027 (LBL—18945, pp 65-71) **Collective effects for an FEL storage ring.** Bisognano, J.J. Dec 1984. NTIS, PC A04/MF A01. File Number DE85009968.

In Coherent x-rays and vacuum-ultraviolet radiation from storage-ring-based undulators and free electron lasers.

High-performance operation of a free electron laser (FEL) requires a stored beam with both significant volume density (large peak current and small emittance) and low momentum spread. These conditions place severe demands on storage-ring dsign, which must address the impact of both coherent and incoherent multiparticle phenomena. The basic goal remains optimization of

the FEL gain parameter rho. Some preliminary storage-ring studies imply that currents of several hundred amperes are consistent with horizontal emittance ϵ/sub x/ and longitudinal σ/sub p/ at the 10^{-8}m-rad and 10^{-3} level, respectively, at low energies (500 MeV). For typical undulator designs, these storage-ring parameters yield a rho of about 10^{-3}. This result is encouraging. 6 references, 2 figures.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 44010022438, 22648, 23235

23028 (BNL—35710) **CaF_2:Mn thermoluminescence: a single glow peak not described by 1st or 2nd order kinetics.** Hornyak, W.F.; Levy, P.W.; Kierstead, J.A. (Maryland Univ., College Park (USA)). Dec 1984. Contract AC02-76CH00016. 23p. (CONF-8409192—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009828.

From 4. international seminar on TL and ESR dating; Worms, F.R. Germany (1 Sep 1984).

The thermoluminescence (TL) of CaF_2:Mn has been studied using photon counting and digital recording. For doses of 10 rad or less the TL glow curves appear to consist of a single glow peak. However, there are indications - which are pronounced at larger doses - that one additional low intensity peak (area $\leq$ one percent) is superimposed on each side of the central peak. The intense peak is not described by 1st or 2nd order kinetics but is well described by the more general kinetics from which these kinetics are derived. These observations, and the results of additional kinetic analysis, demonstrate that retrapping is not negligible and may include all three peaks. In such systems, which are likely to include other dosimeter materials and minerals, peak height will not increase linearly with dose; an important factor for dosimetry and dating applications.

23029 (DOE/ER/10275—1B, pp 26) **Neutron/gamma ray radiation monitor.** Korsah, J.K. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23030 (DOE/ER/10275—1B, pp 27) **SEFOR Calibration Center.** Brandon, W.E. (Univ. of Arkansas, Fayetteville). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23031 (DOE/ER/10275—1B, pp 29) **Dose measurements behind reduced shielding at the Texas A and M University variable energy cyclotron.** Kay, D.C. (Texas A and M Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23032 (DOE/ER/10275—1B, pp 30) **Investigation of iodine loading onto charcoal filters used in air sampling equipment.** Langhorst, S.M. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23033 (DOE/ER/10275—1B, pp 34) **Measurement of the time response of an NE-213 scintillator.** Navab-Irani, A. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23034 (DOE/ER/10275—1B, pp 38) **Measurements of the gamma abundance of ^{31}Si.** Parma, E.J. Jr.; Hart, R.R. (Texas A and M Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23035 (DOE/ER/10275—1B, pp 52) **Optimization of neutron-to-light converter screens for use in real-time neutron radiography.** Lindsay, J.T. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

In neutron radiography, as in other forms of NDE, it is sometimes desirable to observe dynamic events. This need has generated increased interest in the development of real-time neutron radiography systems and neutron-to-light converter screens optimized for real-time application. Two screens currently available at MURR are: (1) a 0.041-cm-thick Gd_2O_2S screen manufactured by 3M Company and (2) a ^{6}KiF-ZnS(Ag) screen (NE 426) manufactured by Nuclear Enterprises. These screens are presently used in conventional film neutron radiography and represent two of the commercially available screens that have demonstrated the greatest resolution and sensitivity. Unfortunately, these screens have severe limitations when used for real-time neutron radiography. In order to isolate and minimize the factors contributing to these limitations, several neutron absorbers and phosphorus were studied at MURR. The screen thickness and the neutron absorber/phosphorus weight ratio was also varied and the resulting screens evaluated with respect to their sensitivity and MTF.

23036 (DOE/ER/10275—1B, pp 55) **MTF analysis of the MURR real-time neutron radiography facility.** Lindsay, J.T. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

In neutron radiography, as in other forms of NDE, it is sometimes desirable to observe dynamic events. This need has generated increased interest in real-time neutron radiography systems. As in other forms of radiography, a standard method for measuring the image forming capability of real-time systems is necessary in order to compare the various methods and systems used. A technique which has been used extensively in general photography and has been applied in the characterization of several screen-film combinations used in conventional neutron radiography is to determine the imaging system's modulation transfer function (MTF). This gives a graphical representation of the system's spatial resolution capabilities and was therefore chosen as the method for evaluation of the real-time neutron radiography facility at the University of Missouri Research Reactor (MURR). The method used was to image a knife-edge, differentiate the edge gradient to obtain the line spread function (LSF) to obtain the system MTF. A Gd foil was used for the knife-edge on several neutron converter screens and was imaged by a low-light level ISIT camera. The video signal was then digitized and presented to a PDP-11/05 microcomputer for the numerical calculations.

23037 (N—85-13560) **Scintillator-fiber charged particle track-imaging detector.** Binns, W.R.; Israel, M.H.; Klarmann, J. (Washington Univ., St. Louis, MO (USA)). 1983. 28p. (NASA-CR—174160). NTIS, PC A03/MF A01.

A scintillator-fiber charged-particle track-imaging detector was developed using a bundle of square cross section plastic scintillator fiber optics, proximity focused onto an image intensified charge injection device (CID) camera. The tracks of charged particle penetrating into the scintillator fiber bundle are projected onto the CID camera and the imaging information is read out in video format. The detector was exposed to beams of 15 MeV protons and relativistic Neon, Manganese, and Gold nuclei and images of their tracks were obtained. Details of the detector technique, properties

of the tracks obtained, and preliminary range measurements of 15 MeV protons stopping in the fiber bundle are presented.

23038 (CE-Trans—8058) Moessbauer spectroscopy with multiwire proportional chambers. Zhang Yi Qun; Zhu Jun Jie; Wang Xiao Lian. Translated from *Journal of China University of Science and Technology (Chengdu) ;* 12: No. 3, 60-66(Sep 1982). 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901137. DE85901137

This article introduces transmission type Moessbauer spectroscopy with multiwire proportional chambers, which is especially suited to fast sample analysis and consequently is advantageous towards increasing precision in measurement. The construction and principles of multiwire proportional chambers are discussed and measurement results of chamber performances are given. This equipment has a better energy resolution rate and a higher detection rate with regard to 14.4 KeV γ-rays radiated from a Moessbauer source; more especially, it has a higher count rate response, its highest count rate being 2×10^6 cps. Finally, a Moessbauer spectrogram from this spectroscopy is given.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 44020022998

23039 (SAND—84-2678C) Summary of recent studies on AlGaAs/GaAs radiation hardened photodiodes. Wiczer, J.J. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-850345—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009501.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

In this paper, we summarize the results of several studies assessing the radiation hardness of a new type of double heterojunction, AlGaAs/GaAs photodiode. These studies include transient and permanent damage experiments. Transient studies indicate that double heterostructure AlGaAs/GaAs photodiodes generate 40 times less photocurrent than conventional silicon photodiodes during exposure to ionizing-radiation pulses. Permanent damage studies with neutrons, Co^{60} gamma rays, and high energy electron beam sources indicate only minor changes in operational characteristics after exposures. These studies have shown a 20% degradation in optical response and a factor of 8 increase in photodiode leakage current after exposure to 3.6×10^{15} neutron/cm^2 fluence. Conventional silicon photodiodes exhibit this type of degradation after exposures to 10^{12} to 10^{13} neutrons/cm^2 fluences. These characteristics are important for many specialized applications requiring radiation hardness.

23040 (SAND—85-0346C) Electron spin resonance study of interface states induced by electron injection in metal-oxide-semiconductor devices. Mikawa, R.E.; Lenahan, P.M. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009502.

Structural damage at the Si/SiO_2 interface in metal-oxide-semiconductor devices resulting from the emission of electrons from the silicon into the oxide involves an amphoteric trivalent silicon defect, termed P/sub b/. The P/sub b/ center is responsible for the electron injection induced interface states. The effects of electron injection are similar to those of ionizing radiation to the extent that in both cases P/sub b/ centers are generated at the Si/SiO_2 interface. However, the effects are not identical; ionizing radiation creates another trivalent silicon defect, termed E', in the oxide. We are unable to observe any E' generation in oxides subjected to electron injection. There appears to be a strong correlation between the number of trapped electrons and the electron injection induced P/sub b/ center interface states; this observation suggests that the trapping of electrons in the bulk of the oxide is in some way related to the creation of the P/sub b/ center interface state defects. In addition, dry oxides subjected to a deuterium/nitrogen anneal exhibit less electron trapping than otherwise identical oxides which have been subjected to a hydrogen/nitrogen anneal. This observation is consistent with the idea that a hydrogen bond breaking event may be involved in electron capture.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 44030022362, 22566, 22637, 23019, 23312

23041 (DOE/ER/12019—T1) Combustion control with smart sensors. Annual technical progress report. Wolga, G.J. (Cornell Univ., Ithaca, NY (USA)). 1984. Contract AC02-82ER12019. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009419.

The overall objectives of the program reported were: to develop a smart infrared spectroscopic sensor capable of quantitatively monitoring CO_2, CO, and NO at concentration levels representative of conditions to be found beyond the primary combustion stage of a fossil fuel power plant; to test the sensor in the laboratory first under static gas conditions in a test cell and then in the exhaust stream of one or more types of laboratory combustors; and to apply the smart sensor in a control loop to demonstrate combustion control of a multi-burner furnace. The smart infrared spectroscopic sensor is based on a tunable acoustooptic filter (TAOF) whose principal passband is spectrally positioned by the application of a radio frequency acoustic wave to the filter. The TAOF operates on the principle of coherent, acoustooptic diffraction of a narrow band of radiation (e.g., infrared) in a birefringent crystal medium (in this case $TlAsSe_2$). The diffracted light is switched to an orthogonal polarization and, in some designs, is also deflected in direction. The filter and a detector are set up to perform differential absorption spectroscopy in which absorption by gaseous combustion products such as CO and CO_2 provide signature infrared absorption over a well defined path. Details are given of instrument design and implementation, preparation of laboratory facilities, analytical studies required for quantitative interpretation of experimental results. (LEW)

23042 (EGG/10282—1077) Pressure measurement: short course. Noyes, R.P. (EG and G Energy Measurements, Inc., Las Vegas, NV (USA)). 1985. Contract AC08-83NV10282. 61p. (CONF-850582—4). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008644.

From 31. ISA international instrumentation symposium; San Diego, CA, USA (6 May 1985).

The measurement of pressure in static and flowing fluids and the measurement of dynamic pressures are covered, as well as calibration of pressure transducers, criteria for selection of pressure transducers, and operation principles of pressure transducers. (LEW)

23043 (EGG/10282—4035) Streak tube characterization. Hinrichs, C.K. (EG and G Energy Measurements, Inc., San Ramon, CA (USA)). Apr 1985. Contract AC08-83NV10282. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009874.

An explanation is given of some of the phenomena that occur in electrostatically focused streak tubes and how they can affect various measurements. These phenomena have to do with the overall tube voltage (cathode to anode/screen), cathode resistivity, space charge effects, chromatic effects (those caused by the spread in energy distribution of photoelectrons), off-axis focus, deflection defocusing, and the phosphor screen. Some important static and dynamic streak tube measurements are then described. The static measurements include those of photocathode spectral sensitivity and uniformity, phosphor screen measurements, tube radiant gain, extinction ratio, static resolution, magnification, and distortion. The dynamic measurements include spatial and time resolution. (LEW)

23044 (EGG-TFBP—6739) Fabrication and use of zircaloy/tantalum-sheathed cladding thermocouples and molybdenum/rhenium-sheathed fuel centerline thermocouples. Wilkins, S.C.; Sepold, L.K. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1985. Contract AC07-76ID01570. 43p. NTIS, PC A03/MF A01 - GPO. File Number TI85009174.

The thermocouples described in this report are zircaloy/tantalum-sheathed and molybdenum/rhenium alloy-sheathed instruments intended for fuel rod cladding and fuel centerline temperature measurements, respectively. Both types incorporate beryllium oxide insulation and tungsten/rhenium alloy thermoelements. These

thermocouples, operated at temperatures of 2000°C and above, were developed for use in the internationally sponsored Severe Fuel Damage test series in the Power Burst Facility. The fabrication steps for both thermocouple types are described in detail. A laser-welding attachment technique for the cladding-type thermocouple is presented, and experience with alternate materials for cladding and fuel therocouples is discussed.

23045 **(HRP—0906254/8/XAB) Nuclear Magnetic Resonance Imaging. South Carolina Health Service Area 2.** (Three Rivers Health Systems Agency, Inc., Columbia, SC (USA)). Dec 1984. 27p. NTIS, PC A03/MF A01.

Contents include: Nuclear Magnetic Resonance Imaging (NMRI); (Clinical applications, Magnet types, Comparisons with other systems, Manpower, Manufacturers, Contraindications); Analysis of systems; (Availability, Accessibility, Cost, Quality, Continuity, Acceptability).

23046 **(RFP—3677) Proving ring calibrations using a deadweight pressure system.** Affatica, J.P.; Grable, A.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 25 Feb 1985. Contract AC04-76DP03533. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009500.

The Rocky Flats Standards Laboratory has devised a method to utilize a deadweight pressure gage to calibrate proving rings to 1050 pounds of force (lbf). The equipment and the necessary modifications are described, as is the setup and operation. The modifications are additions to the main structure of the pressure gage allowing direct force measurements without damaging or permanently altering the pressure gage. Also included are a brief description of the computer program used with the system and an error analysis of the system. This development has increased the Standards Laboratory capabilities; previously, proving rings to be calibrated were sent to the National Bureau of Standards or the Primary Standards Laboratory.

45 EXPLOSIONS AND EXPLOSIVES

23047 **Response of a porous medium to a strong explosion.** Glenn, L.A.; Kidder, R.E. (Lawrence Livermore National Lab., CA (USA)). pp 435-442 of Mechanical properties at high rates of strain, 1984. Proceedings of the 3. conference on the mechanical properties of materials at high rates of strain held in Oxford, 9-12 April 1984. Harding, J. (ed.). Bristol, England; Institute of Physics (1984). (CONF-840411—). Contract W-7405-ENG-48.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

Price Pound 34.00.

An analytical model was formulated for the strong explosion of a finite, spherical source embedded in a porous medium of infinite extent. An exact solution was found for the limiting case of an extremely porous substance and the results were compared with limited experimental data and calculations made with a more elaborate constitutive model.

4501 Chemical

23048 **(AD-A—149473/1/XAB) Investigation of a reusable fuel-air explosive nuclear airblast simulator. Final report, 1 January 1980-1 April 1981.** Pierce, T.H.; Sedgwick, R.T.; Groethe, M.A. (S-Cubed, La Jolla, CA (USA)). 1 Feb 1982. 136p. (SSS-R—81-4897). NTIS, PC A07/MF A01.

Development requirements relating to a reusable, one-kiloton level nuclear airblast simulator using fuel-air explosives is being investigated. The simulator concept is that of a large liquid fuel dispenser, comprising a cluster of radially-directed nozzles. An appropriate fuel would be impulsively injected through this nozzle cluster and the hemispherically-shaped fuel-air cloud so formed would then be detonated. During the contract period reported, work progressed in three areas. These are: the design of an experimental, full-scale single-nozzle dispenser; an initial investigation of the sources of secondary compression waves in fuel-air explosions; and improvements in data acquisition procedures.

23049 **(LA-UR—85-1114) Shock desensitization of PBX-9404 and Composition B-3.** Campbell, A.W.; Travis, J.R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850706—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009604.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

PBX-9404 and Composition B-3 were desensitized by subjecting them to shocks in the pressure range 10 to 24 kbar. Results show that the collapse of voids, and thus the activation of hot spots by shock waves, takes time and may require more than 5 μs. This time is, in a way, a counterpart of the induction time for shock initiation of a homogeneous explosive. Gittings' data are adduced to extend the results to 100 kbar and to show that at high pressures desensitization occurs in a very brief time window. When the voids have been collapsed, the relatively homogeneous explosive is resistant to detonation through an Arrhenius type of reaction because of the lower shock temperature resulting from double shocking. This conclusion is supported by experiments on single crystals of HMX and by shock temperature calculations. The time required for desensitization of PBX-9404 is related to pressure by the expression p/ sup 2.2/tau = 1150. 21 references, 5 figures, 5 tables.

23050 **(LA-UR—85-1129) Equation of state for detonation products.** Davis, W.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850706—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009608.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

The concepts of hydrodynamics and thermodynamics as they apply to equations of state for explosive products are collected and discussed. The physics behind the behavior of dense gases is considered. Some ideas about applications are presented. This paper is intended as an introduction to the subject of equation of state for detonation products. 7 references, 3 figures.

23051 **(PB—85-149078/XAB) Evaluation and comparison of linear and branching delivery systems. Open file report, 29 September 1978-7 August 1984.** Wichser, J.A. (AMAX Coal Co., Indianapolis, IN (USA)). Aug 1984. 103p. NTIS, PC A06/MF A01.

See also PB81-130866.

A series of linear-programmed instruction modules was developed in the general subject areas of blasting technology and explosives safety and electrical training. The programs (modules) were developed in the form of tape and slide plus workbook materials, while the branching format evolved from the Lincoln terminal system from the Massachusetts Institute of Technology, through several other teaching machines and microcomputers, and finally settling on Radio Shack TRS-80 microcomputer models I and III. Initial validation figures indicate that essentially the same results are attained from both methods, with the most noticeable difference being an approximate 25% savings in study time with the branching modules.

23052 **Shock-wave initiation of heterogeneous reactive solids.** Johnson, J.N.; Tang, P.K.; Forest, C.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **57**: No. 9, 4323-4334(1 May 1985).

Shock-wave initiation of solid explosives depends on localized regions of high temperature (hot spots) created by heterogeneous deformation in the vicinity of various defects. Current mathematical models of shock initiation tend to fall into two broad categories: (1) thermodynamic-state-dependent reaction-rate models, and (2) the continuum theory of multiphase mixtures. The level of generality possessed by (1) appears to be insufficient for representation of observed initiation phenomena, while that of (2) may exceed necessary requirements based on present measurement capabilities. As a means of bridging the gap between these two models, we present an internal-state-variable theory based on elementary physical principles, relying on specific limiting cases for the determination of functional forms. The appropriate minimum set of internal-state variables are the mass fraction of hot spots μ, their degree of reaction f, and their average creation temperature θ. The overall re-

action rate lambda-dot, then depends on μ, f, and θ in addition to the usual macroscopic thermodynamic variables (current state as well as their history). Two specific forms of this set of equations are applied to time-resolved shock-initiation data on PBX-9404. Numerical solution is achieved by the method of characteristics for rate-dependent chemical reaction. Additional questions such as the effect of thermal equilibrium between phases (solid reactants and gaseous products) on the theoretical results are discussed quantitatively.

4502 Nuclear

REFER ALSO TO CITATION(S) 45020023196

23053 (AD-A—148997/0/XAB) Operations FLINTLOCK and LATCHKEY events RED HOT, PIN STRIPE, DISCUS THROWER, PILE DRIVER, DOUBLE PLAY, NEWPOINT, MIDI MIST, 5 March 1966-26 Jun 1967. Technical report. Horton, K.K.; Eubank, B.F.; Brady, W.J. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). 1 Oct 1984. 271p. NTIS MF A01.

This report is a personnel-oriented history of DOD participation in underground nuclear weapons testing during Operations FLINTLOCK and LATCHKEY, test events RED HOT, PIN STRIPE, DISCUS THROWER, PILE DRIVER, DOUBLE PLAY, NEW POINT, and MIDI MIST, from 5 March 1966 to 26 June 1967. It is the second in a series of historical reports which will include all DOD underground nuclear weapons tests and all DOE underground nuclear weapons tests with significant DOD participation from 1962 forward. In addition to these historical volumes, a later restricted distribution volume will identify all DOD participants (military, civilian, and civilian contractors) and will list their radiation dosimetry data.

23054 (AD-A—149396/4/XAB) Joint DOD/DOE nuclear weapons accident exercise (NUWAX-79). After action report. Volume 1. Executive summary. (Defense Nuclear Agency, Kirtland AFB, NM (USA)). 24 Apr 1979. 330p. NTIS, PC A15/MF A01.

See also Volume 2, AD-A149 397.

During the period 18-24 April 1979, a Nuclear Weapons Accident Exercise, NUWAX-79, was conducted at the Department of Energy's (DOE) Nevada Test Site (NTS). This exercise was a joint DOD/DOE exercise involving accident response forces from all four Services and the DOE. The purpose of this report is to document all aspects of the exercise so that the lessons learned from the exercise are considered by managers at every level who may have responsibilities during an actual nuclear weapons accident. It is essential that our nation have trained, competent, and ready accident response forces. The experience and knowledge gained in NUWAX-79 will make an important contribution in the improvement of the capabilities of these forces.

23055 (AD-A—149397/2/XAB) Joint DOD/DOE nuclear weapons accident exercise (NUWAX-79). After action report. Volume 2. (Defense Nuclear Agency, Kirtland AFB, NM (USA)). 1979. 44p. NTIS, PC A03/MF A01.

See also Volume 1, AD-A149 396.

A nuclear weapons accident exercise, NUWAX-79, was jointly conducted by the Department of Defense (DOD) and the Department of Energy (DOE) during the period 18-24 April 1979 at the DOE's Nevada Test Site (NTS). The exercise did reveal some weaknesses in our accident response capabilities and the coordination thereof. Interestingly enough, many of the deficiencies were noted by the players themselves - not necessarily the Exercise Control Staff. In putting together the final NUWAX-79 report, both player and Exercise Control Staff personnel cooperated enthusiastically to illuminate those areas in which corrective actions were indicated. This attitude was indicative of that evidenced by Service and DOE personnel throughout the planning and execution phases of the exercise.

23056 (AD-A—149414/3/XAB) Joint DOD/DOE nuclear weapons accident exercise (NUWAX-81) after action report. Volume 1. Executive Summary. (Defense Nuclear Agency, Kirtland AFB, NM (USA)). 28 Aug 1981. 70p. NTIS, PC A04/MF A01.

See also Volume 2, AD-A116 076.

This Executive Summary includes the major lessons learned, recommendations for improvements, and a summary of current initiatives concerning nuclear weapons accident response.

23057 (AD-A—995202/9/XAB) Operation Castle. Joint Task Force Seven, Commander Task Group 7.3. Extracted version. Final report, January-May 1954. Bruton, H.C. (Kaman Tempo, Santa Barbara, CA (USA)). 15 Dec 1982. 375p. NTIS, PC A16/MF A01.

Extracted version of report dated 1954.

23058 (NVO—209-Rev.5) Announced United States nuclear tests, July 1945 through December 1984. Revision 5. (USDOE Nevada Operations Office, Las Vegas). Jan 1985. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010215.

This document lists chronologically and alphabetically by event name all nuclear tests conducted and announced by the United States from July 1945 through December 1983, with the exception of the GMX experiments. The 22 GMX experiments, conducted at the Nevada Test Site (NTS) between December 1954 and February 1956, were "equation-of-state" physics studies that used small chemical explosives and small quantities of plutonium. Several tests conducted during Operation Dominic involved missile launches from Johnston Atoll. Several of these missile launches were aborted, resulting in the destruction of the missile and nuclear device either on the pad or in the air. On August 5, 1963, the United States and the Soviet Union signed the Limited Test Ban Treaty which effectively banned testing of nuclear weapons in the atmosphere. All US nuclear tests conducted prior to that date have been announced and are listed in this document. Some tests conducted underground since the signing of the Treaty and designed to be contained completely have not been announced. Information concerning these events is classified. Occasionally, the name and detonation date of an unannounced test is declassified which permits its listing in subsequent revisions to this document. Data on United States tests were obtained from and verified by the Department of Energy's three weapons laboratories: Los Alamos National Laboratory, Los Alamos, New Mexico; Lawrence Livermore National Laboratory, Livermore California; and Sandia National Laboratories, Albuquerque, New Mexico. Additionally, data were obtained from public announcements issued by the Atomic Energy Commission and its successors, the Energy Research and Development Administration and the Department of Energy, respectively.

4503 Explosion Detection

23059 (AD-A—149009/3/XAB) Broadband discrimination studies. Technical report, 1 October 1978-30 September 1979. McEvilly, T.V.; Johnson, L.R. (California Univ., Berkeley (USA). Seismographic Station). 1 Oct 1979. 36p. NTIS, PC A03/MF A01.

Also available as Rept. Nos. TR-3 and TR-4.

Current studies of the manner in which elastic waves are generated by buried explosions, such as the moment tensor approach, require high-quality broadband ground motion data. In order to obtain such data at distances of a few kilometers from the source, a method or recording the ground motion with force-balance accelerometers and triggered event recorders has been developed and tested. The two NTS events EMMENTHAL and FARM were recorded in the distance range 0.5 - 10 km. A few problems with the method were identified and corrected, and it now appears to be an excellent method of acquiring data from NTS explosions at small distances. The data recorded from EMMENTHAL and FARM illustrate quite clearly a phenomenon that has been observed on records of previous events but still not very well understood. This is the matter of significant energy on the transverse component of motion, some of it arriving at the time of the P wave. This appears to be an important problem worthy of further

study. Its resolution could affect the interpretation of the phases that appear on the radial and vertical components of motion.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

23060 **(PNL-SA—12826) Radiation balance in a deep Colorado valley: ASCOT 84.** Whiteman, C.D.; Fritschen, L.J.; Simpson, J.R.; Orgill, M.M. (Pacific Northwest Labs., Richland, WA (USA); Washington Univ., Seattle (USA). Coll. of Forest Resources). Dec 1984. Contract AC06-76RL01830. 5p. (CONF-850581—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007148.

From 17. conference on agriculture and forest meteorology; Phoenix, AZ, USA (20 May 1985).

Five surface energy budget stations were installed at four sites in a deep, narrow valley in western Colorado as part of the Atmospheric Studies in Complex Terrain (ASCOT) Study. Radiation balance data are presented from these stations for the clear day September 29, 1984. 3 references, 3 figures, 3 tables.

23061 **Overview of the department of energy carbon dioxide research program.** Riches, M.R.; Koomanoff, F.A. (Climate Change, Carbon Dioxide Research Division, Office of Basis Energy Sciences, U. S. Department of Energy, Washington, D. C. 20545). *Bulletin of the American Meteorological Society;* 66: No. 2, 152-158(Feb 1985).

The goal of the Department of Energy (DOE) Carbon Dioxide Research Program is to identify possible policy options for government action in response to effects of increased CO_2. The achievement of this goal requires a significant increase in our scientific knowledge of the atmosphere, the biosphere, the oceans, and the cryosphere-their interactions and the effects that increasing atmospheric CO_2 and other trace gases will have on them. To identify and specify valid choices, a program of directed research is required. The research areas include: Projection of future atmospheric CO_2 concentrations Estimation of Co_2-induced global/regional climate changes Estimation of crop and ecosystem response to CO_2-induced changes Estimation of the effect of CO_2-induced climate changes on sea level, fisheries, and human health. This paper describes the present DOE plan to address the questions related to the global and regional rate of CO_2-induced climate change. The objective of the plan is to define the key questions in such a way that research is directed at experiments where answers are needed rather than at experiments where answers can be easily obtained. Only through this kind of focus can we expect to provide the climate-change estimates required for the policy process.

23062 **Double isotope method for characterizing hygroscopic selenious acid aerosols used in inhalation exposures.** Medinsky, M.A.; Dahl, A.R.; Rothenberg, S.J.; Cuddihy, R.G. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *American Industrial Hygiene Association Journal;* 45: No. 8, 562-566(Aug 1984). Contract AC04-76EV01013.

Methods of generating and characterizing selenious acid aerosols for use in deposition and toxicity studies are described. Selenious acid aerosols were nebulized and heat treated at varied temperatures. Because selenious acid is hygroscopic, a solution containing ^2H_2O and ^{75}Se was nebulized to determine the water content in selenium aerosols after generation. The stable aerosol was a hydrate of selenious acid, H_2SeO_3 1/2 H_2O, at New Mexico ambient relative humidity (ca. 20%). The mass median aerodynamic diameter of the collected droplets was 0.6 μm with a geometric standard deviation of 1.3. 24 references, 4 figures, 1 table.

23063 **Sensitivity analysis of a radiative-convective model by the adjoint method.** Hall, M.C.G.; Cacuci, D.G.; Schlesinger, M.E. (Oak Ridge National Lab., TN). *Journal of the Atmospheric Sciences;* 39: No. 9, 2038-2050(Sep 1982). Contract W-7405-ENG-26.

The adjoint method of sensitivity analysis is demonstrated on a radiative-convective climate model. A single adjoint calculation, which requires about the same computation time as the original model, suffices to calculate sensitivities of surface air temperature to all 312 model parameters. The uses of these sensitivities are discussed and illustrated. The sensitivities accurately predict the effect on surface air temperature of small variations in the model parameters. Relative sensitivities are used to rank the importance of all the parameters. Several of the sensitivities to parameters customarily considered in previous works (e.g., solar constant, surface albedo, relative humidity, CO_2 concentration) are reproduced, but the largest sensitivities are to constants used to compute the saturation vapor pressure of water. The uncertainties in the model results are expressed formally in terms of all the sensitivities and parameter covariances. For results that cannot readily be compared with observation (for example, the results of a CO_2 doubling experiment), this method of uncertainty analysis is the only systematic way to estimate the reliability of model results. The radiative-convective model contains complex nonlinear processes of the type found in general circulation models. Therefore, the fact that the adjoint method works successfully and efficiently for the radiative-convective model provides valuable information about subsequent application of the method to general circulation models.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 50020022363, 22490, 22800, 22801, 22823, 22824, 22921, 22923, 22964, 23006, 23061, 23088

23064 **(AD-A—147690/2/XAB) Air-Quality Assessment Model validation in complex terrain. Final report, October 1981-September 1983.** Wachinski, A.M.; Crow, D.R.; Dustin, J.D.; Seitchek, G.D. (Air Force Engineering and Services Center, Tyndall AFB, FL (USA)). Aug 1984. 75p. NTIS, PC A04/MF A01.

This research was conducted to validate the USAF Air Quality Assessment Model (AQAM) for use in measuring environmental impacts of coal-conversion projects for Air Force heating and power plants located in a complex-terrain scenario. The first step in the project was to conduct a tracer-gas study and gather data to approximate the exhaust plume of the heating plant being studied. The tracer-study methodology is discussed. The rationale behind the sampling-network design, and the procedures used to gather the necessary meteorological data are also covered. The next step was to input the known meteorological conditions and source characteristics to both AQAM and the Environmental Protection Agency's model, COMPLEX II. Both of these models are described. Of particular concern are those parameters which can have a significant impact on the predicted results.

23065 **(ANL—83-100-Pt.4) Atmospheric physics. Environmental Research Division annual report, January-December 1983. Part IV.** (Argonne National Lab., IL (USA)). Dec 1984. Contract W-31-109-ENG-38. 82p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009659.

This report provides a sample of the research conducted in 1983 by the Atmospheric Physics Program of Argonne National Laboratory's Environmental Research Division. The majority of the research described deals with atmospheric physical processes, but there is a substantial component dealing with chemical processes as well. With the increased emphasis on issues involving the atmospheric behavior and deposition rates of acidifying substances, many of the articles address the transport, diffusion, or deposition of atmospheric sulfur and nitrogen compounds. Numerical modeling and experimental studies are parallel activities in the program and draw upon each other for information and guidance. Separate analytics have been done for each entry in the report.

23066 **(CONF-850585—1) Portable toxic vapor detector and analyzer using an electrochemical sensor array.** Stetter, J.R.; Penrose, W.R.; Zaromb, S.; Nolan, M.; Christian, D.; Hampton, D.; Billings, M.; Steinke, C.; Stull, J.O. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85006882.

From Instrument Society of America conference - DIGITECH/85; Boston, MA, USA (14 May 1985).

Argonne National Laboratory is developing a portable device for the US Coast Guard that warns of hazardous situations caused by the presence of flammable or toxic vapors. The instrument hardware can be divided into four basic sections: the microcomputer, the analog-to-digital data acquisition, the controller, and the pneumatics. The microcomputer, which interfaces with an array of four electrochemical sensors, controls the instrument as it cycles through four modes of operation to collect 16 channels of independent data. The instrument has six pushbutton operations: zero, calibrate, test, identify, select, and universal monitor. A portable prototype detects, identifies, and quantitates unknown vapor mixtures and displays the hazard to users. 9 references, 3 figures, 2 tables.

23067 **(CONF-8503114—2) Program planning using the GMAP procedure in SAS/GRAPH software.** Nelson, T.R.; Farrell, M.P.; Gross, T.J.; White, T.R. (Oak Ridge National Lab., TN (USA); USDOE Office of Energy Research, Washington, DC. Carbon Dioxide Research Div.). 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008356.

From SUGI/SAS Users Group international conference; Reno, NV, USA (10 Mar 1985).

A methodology that produces Program Planning Charts using SAS/GRAPH software has been developed as an aid to program management in the CO_2 Research Program of the US Department of Energy. The methodology uses programs from MAPPER, a front-end program (written by D.A. Dahl) for DISSPLA to produce Logic Flow diagrams. Each research question, or set of questions, which comprise one phase of a research program, is represented by a boxed area containing the title of the particular research question(s). The GMAP procedure of SAS/GRAPH software reads user-supplied information regarding a variable aspect of each research question and shades the boxes accordingly. The result is a color-coded planning chart depicting the user supplied information for the individual research questions and, consequently, the status of the overall program. 4 figures, 1 table.

23068 **(DOE/PC/71253—1) Elemental tracers of source regions of contaminants in precipitation. First quarterly report, November 1, 1984-October 31, 1985.** Rahn, K.A. (Rhode Island Univ., Narragansett (USA). Graduate School of Oceanography). 1 Mar 1985. Contract FG22-84PC71253. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007366.

Start-up accomplishments associated with the project are discussed. This includes equipment acquisition, testing of contamination of sample containers (sandwich bags) and preliminary sampling and analysis of atmospheric precipitations. 2 tables. (MDF)

23069 **(DP-MS—84-118) Microcomputer-controlled system for measuring atmospheric particle fluxes.** Lorenz, R.; Murphy, C.E. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 7p. (CONF-850581—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007910.

From 17. conference on agriculture and forest meteorology; Phoenix, AZ, USA (20 May 1985).

A Hiac/Royco Model 4102 optical airborne particle counter equipped with the Model 1200 sensor was interfaced to an existing data acquisition system. Due to the location of the instruments and data transmission problems, special interfaces and software solutions were required to achieve data transmission and instrument control integrity. System design, instrument operation, and the software and hardware solutions required for operation are described.

23070 **(LIS—34) Survey of the nitrogen oxide emission situation in the Land North-Rhine Westphalia and in the Federal Republic of Germany.** Broeker, G. (Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.)). 1983. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751512.

The oxides of nitrogen are of special importance to the photolytic formation of ozone and as such regarded to be one of the likely causes responsible for the death of fir and spruce trees. In view of this fact the changes are discussed that occured between 1960 and 1980 at the various relevant sources with regard to the amounts emitted. Furthermore, the possibilities of reducing the emissions are discussed. Considering the potentials for reductions, those emission sources are identified which could be effectively controlled by administrative measures.

23071 **(PB—85-137107/XAB) Hazardous/toxic Air Pollutant control technology: a literature review. Final report, October 1983-July 1984.** Shareef, G.S.; Miles, A.J.; Post, B.K. (Radian Corp., Research Triangle Park, NC (USA)). Dec 1984. 275p. NTIS, PC A12/MF A01.

The report summarizes literature on Hazardous/toxic Air Pollutant (HAP) sources and control techniques employed in their reduction and/or destruction. The information was abstracted from an extensive computerized and manual literature search and data base development study. The primary emphasis of the report is on HAP control technology. However, a brief summary of major source categories that emit HAPs is also included. About 70 hazardous/toxic compounds or groups of compounds are covered in this study; most are volatile organic compounds. In the HAP control technology data base, most of the information is for the Synthetic Organic Chemical Manufacturing Industry (SOCMI) source category. However, data are also available for the combustion, solvent-use, and metal-processing industries. The major add-on control techniques for volatile organic HAPs discussed in this report are combustion, absorption, adsorption, and condensation. Combustion techniques include thermal and catalytic incineration, flaring, and disposal of waste streams in boilers and process heaters. The add-on control devices identified in the literature for control of particulate HAP emissions are electrostatic precipitators, baghouses, wet scrubbers, and cyclones. A list of references identified during this study, along with abstracts of those references, is included.

23072 **(PB—85-145134/XAB) Environmental aspects of transportation.** Lima, P.M.; Benson, P.E.; Lago, A.M.; McGeehan, D.D.; Cohn, L.F. (Transportation Research Board, Washington, DC (USA)). 1984. 61p. (TRB/TRR—963). NTIS, PC A04/MF A01.

Library of Congress catalog card No. 84-25439.

The 8 papers in this report deal with the following areas: FHWA procedure for estimating highway user costs, fuel consumption, and air pollution: a microcomputer approach; analysis of ambient carbon monoxide data; cost-effectiveness model for analysis of trade-offs between stationary and transportation emission controls in Baltimore; the feasibility of using computer graphics in environmental evaluations; transportation impacts on the environment in 2003; enhancements for computer-based environmental models; mitigating construction impacts on rural and urban highways; and, stringent transportation measures to reduce vehicular emissions in the New York City metropolitan area.

23073 **(PNL—5500-Pt.3) Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 3. Atmospheric sciences.** Elderkin, C.E. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 69p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009666.

The goals of atmospheric research at Pacific Northwest Laboratory (PNL) are to assess, describe, and predict the nature and fate of atmospheric contaminants and to study the impacts of contaminants on local, regional, and global climates. The contaminants being investigated are those resulting from the development and use of conventional resources (coal, gas, oil, and nuclear power) as well as alternative energy sources. The description of the research is organized into 3 sections: (1) Atmospheric Studies in Complex Terrain (ASCOT); (2) Boundary Layer Meteorology; and (3) Dispersion, Deposition, and Resuspension of Atmospheric Contaminants. Separate analytics have been done for each of the sections and are indexed and contained in the EDB. (MDF)

23074 (UCRL—91122) Effect of DOP heterodispersion on HEPA-filter-penetration measurements. Bergman, W.; Biermann, A. (Lawrence Livermore National Lab., CA (USA)). 9 Aug 1984. Contract W-7405-ENG-48. 19p. (CONF-840806—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009583.

From 18. DOE nuclear airborne waste management and air cleaning conference; Baltimore, MD, USA (13 Aug 1984).

The accuracy of the standard US test method for certifying High-Efficiency Particulate Air (HEPA) filters has been in question since the finding by Hinds, et al. that the dioctyl phthalate (DOP) aerosol used in the test is not monodisperse as had been assumed and that particle-size analyzers, or owls, could not distinguish between different particle-size distributions with the same owl reading. We have studied theoretically and experimentally the filter efficiency for different DOP size distributions with the same owl reading. Our studies show that the effect of varying DOP size distributions on the measured HEPA-filter penetration depends on the light-scattering-photometer response and on the HEPA-filter penetration curve, both measured as a function of particle size. HEPA-filter penetration for a heterodisperse DOP aerosol may be increased, decreased, or remain the same when compared to the filter penetration for monodisperse aerosols. Using experimental HEPA-filter penetration and photometer response curves, we show that heterodisperse DOP aerosols (D/sub cmd/ 0.19 and σ g = 1.4) yield 24% lower penetrations than that for monodisperse DOP aerosols (D/sub cmd/ = 0.3 and σ g = 1.0). This surprisingly small effect of the DOP heterodispersion on HEPA-filter penetration is due to the response function of the owl that is similar to the response of the photometer. Changes in the particle-size distribution are therefore seen in a similar fashion by both the photometer and the owl. We also show that replacing the owl with modern particle-size spectrometers may lead to large errors in filter penetration because the particle-size spectrometers do not provide measurements that correspond to the photometer measurements. 15 references, 16 figures.

23075 Concurrent measurements of ozone dry deposition using eddy correlation and profile flux methods. Droppo J.G. Jr. (Battelle, Pacific Northwest Laboratories, Richland, Washington). *Journal of Geophysical Research;* **90**: No. D1, 2111-2118(20 Feb 1985).

Simultaneous surface layer ozone flux measurements by eddy flux and profile methods are reported with supporting micrometerological data. The results show a close correspondence between the eddy diffusivities of ozone and sensible heat rather than momentum eddy diffusivity. Ozone deposition velocities are computed both from the eddy flux and profile fluxes of ozone. As with eddy diffusivities, these results clearly show the sensible heat analogy giving the better fit with the eddy flux values. These sets of deposition velocities also have a consistent temporal variation, with peak values of up to 1 cm/s at midday changing to less than 0.1 cm/s in the evening.

23076 Rates of dry deposition determined using wet/dry collectors. Feely, H.W.; Bogen, D.C.; Nagourney, S.J.; Torquato, C.C. (Environmental Measurements Laboratory, U.S. Department of Energy, New York). *Journal of Geophysical Research;* **90**: No. D1, 2161-2166(20 Feb 1985).

Daily samples of dryfall were collected during the June 1982 Dry Deposition Measurement Intercomparison Study at Champaign, Illinois, using six Aerochem Metrics wet/dry collectors. Upon completion of the field experiment, these samples were analyzed at the Environmental Measurements Laboratory for pH and for their concentrations of major inorganic constituents. Contamination by rain and bird droppings rendered a number of dryfall samples unusuable. When data for these samples were removed, the remaining data displayed acceptable precision for sulfate, calcium, and magnesium. The measured deposition rates varied between 7 and 73 ng/m^2/s for sulfate, between 7 and 44 for calcium, and between 0.8 and 8.1 for magnesium. The precision of the data for ammonium, nitrate, and phosphate was poor, so we have not calculated deposition rates for these constituents. The measurements of the atmospheric concentrations of sulfate reported by the Illinois State Water Surey have been used to calculate deposition velocities for particulate sulfate for 18 daily samples, even though the aerosol sampler and the dry bucket of the wet/dry collector may not sample the same size population of particulates. These velocities ranged from 0.1 to 1.2 cm/s, with a median value of 0.4 cm/s and a mean of 0.45 +- 0.31 cm/s.

23077 Monodisperse aerosols of ammonium bisulfate and pyrene. Tu, K.W. (Dept. of Energy, New York, NY). *American Industrial Hygiene Association Journal;* **45**: No. 8, 567-571(Aug 1984).

Monodisperse ammonium bisulfate and pyrene aerosols in the size range of 0.1 to 2 μm were produced by condensation, and then characterized. A simple generating system developed for routine laboratory operation was found to be well suited for the production of these two different aerosols. The optimum vaporization temperatures and air flow rates were found to be in the range of: 310-390°C and 1-3 L/min for ammonium bisulfate, and 150-165°C and 1-2 L/min for pyrene. No effect of nuclei material on the particle formation was observed. The ammonium bisulfate aerosol was found to be very sensitive to relative humidity. The aerosols produced from both of the source materials are individual, nearly spherical particles. These monodisperse aerosols are useful for laboratory instrument calibration, inhalation toxicological studies and environmentally related aerosol research. 9 references, 5 figures, 1 table.

23078 Locating vegetation at-risk to air pollution: an exploration of a regional approach. Krummel, J.R.; Gilmore, C.C.; O'Neill, R.V. (Oak Ridge National Lab., TN). *Journal of Environmental Management;* **18**: No. 3, 279-290(Apr 1984). Contract W-7405-ENG-26.

A regional approach was used for locating field research sites to assess the impact from new coal-burning electric generating and synfuel facilities along the Ohio and Green Rivers in western Kentucky. The study region was divided into 1600 grid locations, and the probability of exceeding 3 hr average levels of 210 and 262 mg m^{-3} of sulfur dioxide was calculated for each grid location. Given the higher background levels and the transport distance of sulfur dioxide, only grid locations located along the western Ohio River Valley portion of the study region were found to have a reasonable probability (0.37-1.00) of exceeding the 3 hr average threshold levels of sulfur dioxide during the growing season. The field sites located by this approach were quite different from what one would expect from a site-by-site analysis. Forested and non-forested wetlands, while covering less than 2% of the regional landscape, appeared in 37% of the grid locations that had a reasonable probability of exceeding the two concentrations of sulfur dioxide. This approach identified a vegetation type at-risk which may have been ignored in a site-by-site approach. The incorporation of multiple pollutant sources and multiple receptors provides an efficient method to overlay sulfur dioxide deposition patterns upon the pattern of vegetation in a region. This method provides a basis for locating vegetation types at-risk and siting field research. Such research is especially important if unique vegetation types are flagged by this procedure. 28 references, 1 figure, 3 tables.

23079 Oxygen-18 study of high-temperature air oxidation of SO_2. Holt, B.D.; Kumar, R. (Argonne National Lab., IL). *Atmospheric Environment;* **18**: No. 10, 2089-2094(1984).

The oxygen-18 enrichment in sulfates formed at high temperatures (475-500°C) by platinum-catalyzed air oxidation of SO_2 to SO_3 in humidified air, was found to be several parts per thousand higher than in the air oxygen, SO_2, or water vapor from which the sulfates were formed. Variation of the $\delta^{18}O$ in the sulfates showed little dependence on variation of the $\delta^{18}O$ in the water vapor. The mechanism of sulfate formation involved isotopic exchange between the air oxygen and water vapor, isotopic exchange between the water vapor and SO_2, and formation of the hydrate, $H_2SO_4 \times 3H_2O$. When Fe_2O_3 or V_2O_5 was heated in mixtures of air, water vapor, and SO_2, some of the SO_2 was catalytically oxidized (via SO_3 formation) to sulfate of relatively high $\delta^{18}O$ and the remainder to chemisorbed sulfate of relatively low $\delta^{18}O$. Charcoal and fly ash (containing unburned carbon and basic oxides) reacted with the SO_2 to yield chemisorbed sulfates of relatively low $\delta^{18}O$. 12 references.

23080 Formaldehyde release rate coefficients from selected consumer products. Pickrell, J.A.; Mokler, B.V.; Griffis, L.C.; Hobbs, C.H.; Bathija, A. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Environmental Science and Technology;* 17: No. 12, 753-757(Dec 1983). Contract AC04-76EV01013.

Many consumer products release formaldehyde into the atmosphere in varying concentrations. A modification of the Japanese Industrial Standard (JIS) desiccator test was used to measure formaldehyde release after conditioning for 46 samples from six different types of consumer products (pressed wood products, clothes, insulation, paper, fabric, and carpet). Release rate coefficients were calculated per unit mass ($\mu g\ g^{-1}\ day^{-1}$) and surface area ($\mu g\ m^{-2}\ day^{-1}$) for each product. The latter coefficient was used to rank the products. The eight highest release coefficients were from pressed wood products. More than half (24) of the products had release coefficients that were less than or equal to 100 μg of formaldehyde released $(m^2$ of product surface area$)^{-1}\ day^{-1}$. Individual samples from five of the six types of products were represented in this class. The fraction of total extractable formaldehyde released each day under JIS desiccator conditions at loading of 21 m^2/m_3 was calculated. Wood products and carpets released ~ 1-4% of total extractable formaldehyde per day while fiberglass insulation released ~ 10% per day under the conditions of this 2-day test procedure. 21 references, 1 figure, 3 tables.

23081 Aerosol concentrator: design, construction, calibration, and use. Barr, E.B.; Hoover, M.D.; Kanapilly, G.M.; Yeh, H.C.; Rothenberg, S.J. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Aerosol Science and Technology;* 2: 437-442(1983). Contract AC04-76EV01013.

A simple, inexpensive device has been designed to concentrate aerosols. It has been successfully used to concentrate up to 90% of an aerosol in 10% of volumetric flow rate. In an exposure line, the device also removes excess water vapor and small satellite particles from test aerosols. The versatility of the concentrator has been demonstrated in its use for removing excess SO_2 and NH_3 from bisulfite exposure aerosols. 5 references, 5 figures.

23082 Sources and surface-area distributions of atmospheric particles. Slinn, W.G.N. (Pacific Northwest Lab., Richland, WA). *Atmospheric Environment;* 17: No. 11, 2363-2364(1983). Contract AC06-76RL01830.

A figure is presented which displays the particulate sizes typical of various sources of particulate air pollution (e.g., auto traffic, urban air pollution, smog, volcanic plumes) and the particulate size distributions considered typical background. 8 references, 1 figure, 1 table.

23083 Comments on MAP3S/RAINE precipitation chemistry statistics. Hales, J.M. (Pacific Northwest Laboratories, Richland, WA). *Atmospheric Environment;* 17: No. 9, 1853-1854(1983).

This paper is a correction note referring to a previous paper published on the MAP3S/RAINE system. An error in the original paper is described, and interpretive differences arising from that error are discussed.

23084 Fluxes of gases and particles above a deciduous forest in wintertime. Weseley, M.L.; Cook, D.R.; Hart, R.L. (Argonne National Lab., IL). *Boundary-Layer Meteorology;* 27: 237-255(1983).

Eddy-correlation measurements of the vertical fluxes of ozone, carbon dioxide, fine particles with diameter near 0.1 μm, and particulate sulfur, as well as of momentum, heat and water vapor, have been taken above a tall leafless deciduous forest in wintertime. During the experimental period of one week, ozone deposition velocities varied from about 0.1 cm s^{-1} at night to more than 0.4 cm s^{-1} during the daytime, with the largest variations associated primarily with changes in solar irradiation. Most of the ozone removal took place in the upper canopy. Carbon dioxide fluxes were directed upward due to respiration and exhibited a strong dependence on air temperature and solar heating. The fluxes were approximately zero at air temperatures less than 5°C and approached 0.8 mg $m^{-2}\ s^{-1}$ when temperatures exceeded 15°C during the daytime. Fine-particle deposition rates were large at times, with deposition velocities near 0.8 cm s^{-1} when turbulence levels were high, but fluxes directed upward were found above the canopy when the surface beneath was covered with snow. Diffusional processes seemed to dominate fine-particle transfer across quasilaminar layers and subsequent deposition to the upper canopy. Deposition velocities for particulate sulfur were highly variable and averaged to a value small in magnitude as compared to similar measurements taken previously over a pine forest in summer.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 50030023073, 23151

23085 (DPST—85-285) Radioactive "hot spots" from nuclear weapons test fallout. Sanders, S.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 11 Feb 1985. Contract AC09-76SR00001. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010225.

In a paper presented on January 8, 1985, at the Health Physics Society Midyear Symposium, Franke and Alvarez claimed that radioactivity observed on the Savannah River Plant site on March 14, 1955, was the result of a reactor accident. The source of the observed radioactivity was, in fact, rainwater containing radioactive products from a nuclear weapon test made two days earlier in Nevada. The weapon test TEAPOT HORNET was shown to be the source of the contamination at the time, and this has been corroborated in two recent papers. The aim of this review is to show that the highly-localized radioactive fallout on the Savannah River Plant site was not unique but part of a widespread phenomenon occurring all over the United States in the 1950s and early 1960s. 18 references, 2 figures, 2 tables.

23086 Validation of the AIRDOS-EPA computer code by simulating intermediate range transport of ^{85}Kr from the Savannah River Plant. Fields, D.E.; Miller, C.W.; Cotter, S.J. (Oak Ridge National Lab., TN). *Atmospheric Environment;* 18: No. 10, 2029-2036(1984). Contract W-7405-ENG-26.

The AIRDOS-EPA computer code is used to estimate the annual doses to the general public resulting from releases of radionuclides to the atmosphere. It has been chosen by the US EPA as part of the process for setting radionuclide emission standards for US NRC licensed facilities and US DOE facilities. This code uses a modified Gaussian plume equation to estimate air concentrations resulting from the release of a maximum of 36 radionuclides. Radionuclide concentrations in food products are estimated from the output of the atmospheric transport model using the terrestrial transport model described in US Nuclear Regulatory Commission Regulatory Guide 1.1109. Doses to man at each distance and direction specified are estimated for up to eleven organs and five exposure modes. One year of weekly average ^{85}Kr concentration observed at 13 stations located 30-150 km distant from a point source at the Savannah River Plant, Aiken, South Carolina, have been used in a validation study of the atmospheric transport portion of AIRDOS-EPA. The predicted annual average concentration at each station exceeded the observed value in every case. The overprediction factor ranged from 1.4 to 3.4 with an average value of 2.4. Pearson's correlation between pairs of logarithms of observed and predicted values was r=0.93. As the averaging time of the prediction decreases, however, the uncertainty in the prediction increases. For example, monthly values show more scatter than do annual or seasonal values. When observed and predicted values or the seasonal average concentrations for each station were compared, we found increasing agreement as we compared spring, summer, fall, and winter values. 26 references, 8 figures, 2 tables.

23087 (ORNL-tr—5206) Question of the relationship between forest dieback and the operation of atomic plants: a preliminary report. Reichelt, G. (Oak Ridge National Lab., TN (USA); Aktionsgemeinschaft Natur- und Umweltschutz Baden-Wuerttemberg e.V., Stuttgart (Germany, F.R.)). [1985]. Contract AC05-84OR21400. Translation source information not available . 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008574.

It is impossible to know the causes for the forest decline without exact knowledge about the geographical pattern of the

damages. Maps of isolines of the mean degree of damage for spruce presented in this paper show that there are relations between industrial areas or single industrial plants, and degree of damage. Band-like zones of damage extend from such sources of emission more than 50 km, depending on the frequency of winds. Heavy damage is also observed around nuclear plants. Some examples are presented. Referring to available literature, possible causes for these damages are suggested. An exact examination of the relations, using various methods, is urgently needed. 21 references, 5 figures.

5006 Regulations

REFER ALSO TO CITATION(S) 50060023070

23088 **(PB—85-140630/XAB) Maps depicting nonattainment areas pursuant to Section 107 of the Clean Air Act - 1984.** Yarn, J.; Beal, W.; Tate, C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jul 1984. 228p. (EPA—450/2-84/006). NTIS, PC A11/MF A01.

See also PB82-232174.

This report is a detailed mapping of the United States depicting those areas not attaining the National Ambient Air Quality Standards for carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide and total suspended particulates. It includes non-attainment area maps and supporting lists from Federal Register publications for final actions through July 1, 1984.

23089 **(PB—85-150316/XAB) Emissions trading: an overview of the EPA (Environmental Protection Agency) policy statement. Research report.** Brady, G.L.; Morrison, R.E. (National Science Foundation, Washington, DC (USA). Div. of Policy Research and Analysis). 26 May 1982. 39p. (NSF/PRA—82013). NTIS, PC A03/MF A01.

The Environmental Protection Agency's Emissions Trading Statement is examined. The Statement consolidates the emission reductions achieved and used through current administrative procedures for the bubble, netting, offset, and banking programs into a common currency: the Emission Reduction Credit (ERC). The Statement provides guidelines for air quality management regions to develop generic state implementation plan provisions governing transactions in ERCs. The Statement invites firms to create surplus discharge reductions beyond current control requirements. The incentive for participation is the opportunity to make a profit by selling ERCs to other firms that face higher marginal emissions control costs. The existing regulatory implementation incentive structure for stationary source dischargers is described, and the evolution of the Statement is traced. Issues that may limit the cost-effectiveness of the ERC program are considered.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 51010022734, 23177

23090 **(BNL—51826) Population and habitat dynamics of the white-footed mouse (Peromyscus leucopus) in a heterogeneous forest.** Ormiston, B.G. (Brookhaven National Lab., Upton, NY (USA)). Jul 1984. Contract AC02-76CH00016. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009279.

Movements and demography of white-footed mice (Peromyscus leucopus) were determined by live-trapping and radiotelemetry in contiguous upland and lowland forest habitat to assess the extent of variation in local habitat distribution due to season, age, and sex factors. Mice were marked and recaptured monthly in 1980 and 1981 from April through December on a continuous 20 ha trapping grid, thus yielding 1486 captures of 397 individuals. Locations and activity of 43 mice were determined by radiotracking. Various measures of habitat suitability, including adult density, sex ratio, reproduction, persistence, home range size, and immigration, indicated a seasonal cycle of habitat suitability. Upland habitat appeared better for overwintering, and lowland habitat was superior relative to the upland from June through October. Tendencies for breeding females to be restricted to lowland, and for lowland males to display greater mean body weights and smaller home range sizes than upland males, were attributed to greater food availability in the lowland over this period. Individual P. leucopus use local habitats opportunistically, but variations in habitat distribution between the age- and sex-classes of the population noted during the breeding season suggest that local habitats provide a spatial framework for behavioral population regulation in P. leucopus. 49 references, 5 figures, 10 tables.

23091 **(FRNC-TH—1727) Modeling heat and water transfers in the ground. Application to the heat extraction by a heat pump coupled with an horizontal network of buried pipes.** Dunand, A. (Grenoble-1 Univ., 38 (France); Institut National Polytechnique, 38 - Grenoble (France)). Oct 1982. 207p. (In French). NTIS (US Sales Only), PC A10. File Number DE85751003.

This work deals with the construction of various models of coupled heat and mass transfers in non frozen ground. A model of two-dimensional heat calculation and a single-dimensional water calculation with a ground-atmosphere exchange are then developed. A comparison of values computed through this model with the measurements made on the Renardieres EDF experimental site is finally presented.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 51020022461, 22729

23092 **(CONF-850314—35) DOE Hazardous Waste Program.** Eyman, L.D.; Craig, R.B. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009287.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The goal of the DOE Hazardous Waste Program is to support the implementation and improvement of hazardous-chemical and mixed-radioactive-waste management such that public health, safety, and the environment are protected and DOE missions are effectively accomplished. The strategy for accomplishing this goal is to define the character and magnitude of hazardous wastes emanating from DOE facilities, determine what DOE resources are available to address these problems, define the regulatory and operational constraints, and develop programs and plans to resolve hazardous waste issues. Over the longer term the program will support the adaptation and application of technologies to meet hazardous waste management needs and to implement an integrated, DOE-wide hazardous waste management strategy. 1 reference, 1 figure.

23093 **(PB—85-137354/XAB) Effects of SO_2 on a grassland: a case study in the northern Great Plains of the United States.** Lauenroth, W.K.; Preston, E.M. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.; Colorado State Univ., Fort Collins (USA)). Nov 1984. 359p. (EPA/600/3—84/107). NTIS, PC A16/MF A01.

Prepared in cooperation with Colorado State Univ., Fort Collins.

This report documents a project started in 1972-73 to determine the bioenvironmental impacts of coal-fired power plants. Details of the experiments are found in the published literature and annual reports listed in the bibliography. In this text findings are generalized in chapters presenting the outline and overview of the problem, descriptions of the study sites and the SO_2 exposure system, summaries and interpretation of the results of the field experiments which are then incorporated into simulation modeling exercises. Results are interpreted in the context of potential impacts of energy development in the northern Great Plains, other grasslands, and other ecosystem types.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 51030022462, 22734, 23150

23094 **(EGG/10282—1049) Aerial radiological survey of the Savannah River floodplain. Date of survey: July-October 1983.** Boyns, P.K. (EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.). Dec 1984. Contract AC08-83NV10282. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010005.

An aerial radiological survey of the Savannah River floodplain was conducted from late July through early October 1983 by EG & G Energy Measurements, Inc. for the United States Department of Energy, Office of Nuclear Safety, and E.I. Du Pont de Nemours & Company, Inc., Savannah River Plant. The survey consisted of airborne measurements of both natural and man-made gamma radiation emanating from the terrestrial surface. These measurements allowed an estimate of the distribution of isotopic concentrations in the floodplain area. Results are reported as isopleths superimposed on maps and aerial photographs of the area. Gamma ray energy spectra are also presented for the net man-made radionuclides. The survey was designed to cover all the Savannah River floodplain (over 8000 flight line miles) from Augusta to Savannah, Georgia. Several areas of man-made activity were detected in the vicinity of the Savannah River Plant (SRP). The presence of ^{60}Co was not detected below the Lower Three Runs Creek area. The ^{137}Cs activity decreased rapidly below Lower Three Runs Creek; at a distance of 15 kilometers (9 miles) the annual dose due to ^{137}Cs was less than 10 millirem (mrem). Typical backgrounds in the survey areas were between 65 and 125 mrem per year. 4 references, 51 figures, 8 tables.

23095 **(EGG/10282—1063) Aerial radiological survey for ^{241}Am contamination in Tonawanda, New York. Date of survey: May 1984.** Clark, H.W. (EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.). Oct 1984. Contract AC08-83NV10282. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010134.

An aerial survey for ^{241}Am contamination was conducted over a portion of Tonawanda, New York during the period 18 through 25 May 1984. The survey was conducted in three phases: (1) hovers, (2) a high altitude total gamma survey, and (3) a low altitude survey for ^{241}Am. No radiation anomalies associated with ^{241}Am were observed in the high altitude survey phase. However, two areas of ^{241}Am contamination were identified by the low altitude survey phase. Results of both aerial survey phases are presented on aerial photographs of the area. 2 references, 2 figures.

5104 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 51040022453

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 51050022329, 22377, 22421, 22422, 22423, 22440, 22441, 22444, 22464, 22732

23096 **(DOE/EIS—0077-DS) Crow Butte Slough Crossing. Supplement to final EIS, Ashe-Slatt (Pebble Springs) 500-kV transmission line.** (USDOE Bonneville Power Administration, Portland, OR). Sep 1981. 133p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85008871.

The proposed action is to construct a 4700-ft segment of the Ashe-Slatt transmission line at Crow Butte Slough, overhead on towers on the existing right-of-way. Alternatives to the proposal include undergrounding the line on the right-of-way or on an existing causeway off the right-of-way, and no action (removing an existing temporary overhead line). The proposed action will result in: temporary disruption (along the right-of-way) and/or destruction (at tower sites) of the habitat, including a wetlands area, and localized noise during construction; both direct (aesthetic) and indirect (recreational) visual effects of the towers and lines, some waterfowl mortality from in-flight collisions, possible corona noise or electric/magnetic effects on some animals, and vegetative control by minor herbicide use during operation. Underground alternatives on the right-of-way cause greater temporary disruption and/or destruction of the habitat, temporary deterioration of the water quality, and possible interference with access to the Crow Butte State Park during construction; terminal station visibility, and possible impacts from accidental chemical (dielectric fluid) releases, from minor uses of herbicides, from cable heat on revegetation, or from cooling station noise to animals during operation.

23097 **(DOE/EIS—0077-SDR) Crow Butte Slough Crossing: study documentation report. Supplement to final EIS, Ashe-Slatt (Pebble Springs) 500-kV transmission line.** (USDOE Bonneville Power Administration, Portland, OR). Sep 1981. 219p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85008842.

This report is the technical appendix to the Bonneville Power Administration (BPA) Draft Environmental Impact Statement (EIS) Supplement to the Final EIS for the Ashe-Slatt 500-kV transmission line (BPA, 1975). The Final EIS was filed with the Environmental Protection Agency in September of 1975. This report contains the data and methodologies which were used to identify, quantify, analyze, and evaluate the potential environmental impacts associated with the various alternatives under consideration for the Crow Butte transmission line crossing.

23098 **(N—85-11410) Land use/land cover.** (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Sep 1982. 38p. NTIS, PC A15/MF A01.

In its the Spectral Imaging Science Working Group, Volume 2, 119-150, N—85-11405 02-43.

The use of remote sensing multispectral systems in urban/suburban land use, and environmental impact from surface mines is discussed. The classification system used in conjunction with the land use/land cover data is included.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 52010022732

23099 **(PB—85-144269/XAB) Eulerian-Lagrangian analysis of pollutant transport in shallow water. Final report.** de Baptista, A.E.; Adams, E.E.; Stolzenbach, K.D. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jun 1984. 143p. (MIT/EL—84/008). NTIS, PC A07/MF A01.

Sponsored by Northeast Utilities Service Co., Hartford, CT, and New England Power Service Co., Westborough, MA.

A numerical method for the solution of the two-dimensional, unsteady, transport equation is formulated, and its accuracy is tested. The method uses a Eulerian-Lagrangian approach, in which the transport equation is divided into a diffusion equation (solved by a finite-element method) and a convection equation (solved by the method of characteristics). This approach leads to results that are free of spurious oscillations and excessive numerical damping, even in the case where advection strongly dominates diffusion. The method is cost-effective in modeling pollutant transport in coastal waters, as demonstrated by two prototype applications: hypothetical sludge dumping in Massachusetts Bay and the thermal discharge from Brayton Point Generating Station in Narragansett Bay.

23100 **Rotating octagonal floating fish pen to minimize effects of position on experimental variables.** Poston, T.M.; Abernethy, C.S.; Strand, J.A.; Skalski, J.R.; Genoway, R.G. (Pacific Northwest Lab., Richland, WA). *Progressive Fish-Culturist;* 46: No. 1, 29-35(Jan 1984). Contract AC06-76RL01830.

A device for holding eight experimental stocks of fish in individual pens is described. The device minimizes position effects such as metabolic waste gradients and external stimuli that may occur on fish held in compartmentalized rearing troughs. Conversion ratios of fish held in the pens and a comparison of weight of

fish held in the rotating octagonal floating fish pen are presented to attest to the suitability of the device for maintaining experimental stocks. 3 references, 3 figures, 2 tables.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 52020022325, 22327, 22378, 22379, 22380, 22381, 22430, 22442, 22460, 22734, 22923, 23102, 23173

23101 **(LBL—19106) Monitoring of subsurface contaminants with borehole/surface resistivity measurements.** Wilt, M.J.; Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). Feb 1985. Contract AC03-76SF00098. 14p. (CONF-850275—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008683.

From 2. national conference and exposition on surface and borehole geophysical methods in ground water investigations; Ft. Worth, TX, USA (12 Feb 1985).

Three-dimensional resistivity modeling was performed to simulate the changes in resistivity due to the leakage of fluid contaminants into an aquifer. The simulation represents a case where the fluid is introduced into a 25 m aquifer at a depth of 45 m. The contaminant fluid is assumed to be electrically more conductive than the in-situ ground water. Resistivity measurements were simulated using a finite difference algorithm to calculate potentials for an arbitrary three-dimensional resistivity distribution with surface and downhole current and potential electrodes. A downhole/surface array was considered where current was injected at the aquifer depth an voltage measurements were made on the surface. We considered cases where current was injected at a point within the contaminant plume as well as outside of the plume (offset case). We considered three contaminant distributions: case 1, the contaminant plume forms a uniform cylinder centered around the injection well; case 2, the plume forms a nonuniform cylinder around the well where contaminant concentration decreases away from the well; case 3, the aquifer has a variable vertical permeability. Results indicate that the anomaly is much greater using the downhole electrode than for surface arrays and that the data may be used to roughly characterize the contaminant mass and its boundaries. Several cases involving different contaminant boundaries were studied and show that the downhole/surface measurements are not very sensitive to differences in the boundary geometry although a rough determination of the boundary position is possible. For the case where the downhole current electrode is located outside of or at the edge of the contaminant, the anomaly size is smaller but the shape allows for good discrimination of the near-side boundary. 6 references, 4 figures.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 52030022439, 22442, 22454, 22458

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 52050022417, 22422, 22423, 22440, 22441, 22444, 22464

23102 **(LA—10327-PR) Water supply at Los Alamos during 1983. Progress report.** Purtymun, W.D.; Becker, N.M.; Maes, M. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010324.

Municipal and industrial water supply for Los Alamos during 1983 consisted of 1463 x 10^6 gal from wells in three fields and 38.2 x 10^6 gal from the gallery in Water Canyon. About 3.4 x 10^6 gal of water from Guaje Reservoir and 1.4 x 10^6 gal from Los Alamos Reservoir were used for irrigation; thus, the total use was about 1506 x 10^6 gal. High-yield Well PM-4 produced 452 x 10^6 gal or about 30% of the total production at Los Alamos during 1983. The primary and secondary chemical quality and radioactivity in water from wells and distribution system are in compliance with federal regulations. 19 references, 20 figures, 7 tables.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

23103 **(DOE/BP—16380-1) Hunter survey final report, Phase I - baseline study. Garrison-Spokane 500-kV transmission project.** Allen, S. (Montana Dept. of Natural Resources and Conservation, Helena (USA)). Nov 1984. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009343.

The State of Montana, in cooperation with the US Forest Service and the Bonneville Power Administration, is conducting a five-year study on the impacts on elk security habitat and hunter opportunity in western Montana of a 500 kV transmission line. Potential impacts stem from the new and upgraded access roads required for the line, which may reduce summer/fall security habitat and make hunting areas less remote. The line itself could affect the aesthetics of popular hunting areas located along the route. As part of this monitoring program, the Montana Department of Natural Resources and Conservation is surveying hunters at seven check stations in the project's two study areas. The hunter survey research has three phases. Phase I was conducted in fall, 1983, to collect baseline data on hunting use and quality in the study areas. After the line is constructed and energized, the Phase II survey, scheduled for fall, 1985, will test hypotheses developed from baseline data to assess the project's impacts on hunting use. During Phase III, scheduled for fall, 1986, the persistence of any impacts identified will be measured. Reports from each phase will be issued to the Interagency Wildlife Technical Committee [chaired by the Bonneville Power Administration]. The data will also be used by the Montana Department of Fish, Wildlife, and Parks, both to help manage elk and to assist in US Forest Service Land management planning. Over 600 hunters were interviewed using a questionnaire developed by DNRC and reviewed extensively by state and federal agencies. The survey form contained questions on hunters' reasons for choosing the study areas as places to hunt, hunting success and related information, previous hunting experience, hunting area evaluations, place of residence, and age. The data were tabulated to describe the 1983 baseline data, and then subjected to cluster analysis. 36 references, 1 figure, 9 tables. (ACR)

5302 Assessment Of Energy Technologies

23104 **(DES—75-38) Draft Environmental Statement: fiscal year 1977 proposed program.** (Bonneville Power Administration, Portland, OR (USA)). 15 Jul 1975. 230p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85009654.

The action is the proposed construction of fiscal year 1977 new facility additions and modifications to BPA's electric transmission system including approximately 88 miles of transmission lines; six new substations and related structures, including power system control stations; maintenance of approximately 12,600 miles of existing transmission lines including tower structures, conductors, and access roads; control of vegetation on approximately 18,000 acres of transmission line rights-of-way and 860 acres of substation property. The proposed program would result in the diversion of approximately 300 acres of forested land to other land uses compatible with transmission line rights-of-way; the permanenet removal of approximately 65 to 75 acres of vegetative cover; the removal of approximately 1 acre of cropland from production; visual impacts to two recreational and one potential recreational waterway and three scenic roadways; disturbance of topsoil, temporary wind and water erosion, and a resultant increase in siltation and turbidity in two major waterways and numerous small and intermittent streams with consequential temporary adverse effects on fish mortality and spawning habitat; the introduction of particulates and combustion byproducts into the atmosphere during open burning of slash; introduction of herbicides into the environment; temporary reduction in wildlife habitat due to herbicides and clearing operations; audible noise during operation of construction equipment and transmission lines and substations; increased risk of man-caused accidents; and maintenance of a high standard of living and level of productivity

for the Pacific Northwest through continued availability of reliable electric service.

23105 **(DOE/EA—0251) International 345 kV transmission line to Highgate, Vermont: environmental assessment.** (USDOE Economic Regulatory Administration, Washington, DC. Coal and Electricity Div.). Feb 1985. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009801.

The action under consideration is the issuance of a Presidential permit to the Vermont Electric Power Company, Inc. (VELCO) for the construction, operation, maintenance and connection of a facility that will cross the United States-Canada border for international transmission of electric energy. The proposed transmission facilities will consist of a 7.5 mile, alternating current (ac) transmission line and a 200 MW back-to-back direct current (dc) converter terminal station. None of the facilities will involve any polluting emissions. The construction and maintenance of the proposed converter terminal station and transmission facilities will have little or no impact on the geologic features of the region. The transmission line will have little or no effect on agricultural land. Impacts on commercial forestry in the area will be minimal. The proposed route will require clearing about 36 acres of forest. The proposed transmission line and converter terminal site will have no effect on recreational activities, mining activites, residential, commercial, or industrial land use. The proposed corridor will have a minimal impact on area terrestrial wildlife and plant communities. The proposed project will have little or no impact on future population distribution, the operation of local services, employment and economic benefit, or housing in either Franklin or Highgate. 16 references, 3 figures. (ACR)

23106 **(DOE/EA—0253) Proposed Near Term Intertie Access Policy: environmental assessment.** (USDOE Bonneville Power Administration, Portland, OR. Office of Power and Resources Management). Feb 1985. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85008487.

The proposed Policy will govern access by all entities to BPA's portion of the Intertie. Assured Delivery will be provided for BPA firm sales and for other firm contracts of Pacific Northwest (PNW) utilities, if approved under the standards established by the Policy. Hourly access will be allocated among BPA and scheduling utilities, with priority access being reserved for the surplus power of PNW utilities. Capacity not needed for PNW surplus may be made available for extraregional utilities. The proposal will grant access to existing resources only, as did the Interim Policy. In addition to this limitation, the proposal carries the same provisions as the Interim Policy protecting against adverse effects on fish and wildlife due to operation of resources. Environmental analysis indicates that the proposal will have no significant environmental impacts, based on the following conclusions: (1) The proposal does not promote new resource development and thus does not result in associated environmental effects; (2) The total amount of generation in the PNW and Pacific Southwest (PSW) will not change as a result of the proposal; (3) Any changes in PNW hydrosystem operations will be insignificant; (4) There will be no significant environmental impacts from PNW thermal resource operations because: (a) the amount of additional thermal generation due to the policy, if any, will be small relative to total thermal generation; (b) resources will not be operated beyond levels which may occur in the absence of the proposal; (c) PNW thermal resources are regulated by licenses or permits which limit operations to acceptable ranges; and (d) PNW thermal will continue to be displaced by low cost NW and Canadian hydro; and (5) The proposal does not promote transmission development and thus does not result in associated environmental effects.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 55020022923, 23136, 23139

23107 **(BNL—36194) Small cyclotrons and the production of positron emitters: present and future.** Wolf, A.P.; Fowler, J.S. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 35p. (IAEA-CN—45; CONF-841022—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85009767.

From International conference on radiopharmaceuticals and labelled compounds; Tokyo, Japan (22 Oct 1984).

Small cyclotrons play a central role in what is a multi- and interdisciplinary biomedical research and clinical applications field, actively growing at this writing. Although the use of positron emitters, produced using these machines, as the metabolic and physiologic probes in studying animal and human physiology and pathophysiology had its beginnings in the late 30's and early 40's, the current widespread interest had its origins in research which was started in the mid 60's. This manuscript will address the current status and future prospects of positron emitters in the overall context of their detection and application. The three areas of greatest emphasis will be cyclotrons, positron emitting radionuclides, and positron labeled precursors, and radiotracer synthesis and application. 75 references, 8 figures, 3 tables.

23108 **(LBL—19276) I. Kinetics of oligodeoxynucleotide double strand formation and the interaction of an uncharged intercalator with DNA. II. The aqueous photochemistry of 4'hydroxymethyl-4,5',8-trimethylpsoralen.** Kao, J.P.Y. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 235p. NTIS, PC A11/MF A01; GPO Dep. File Number DE85009929.

Thesis.

Two deoxyoligonucleotide duplexes were studied by temperature-jump relaxation kinetic experiments: $dCA_4G + dCT_4G$, a completely base-paired duplex, and $dCA_3CA_3G + dCT_4G$, a bulged duplex containing an extra unpaired cytosine. The kinetics of forming the perfect duplex is simply described by a single step, characterized by a recombination and a dissociation rate constant. Formation of the bulged duplex proceeds with a recombination rate constant which decreases with increasing temperature - recombination occurs with a negative activation energy. HMT, a neutral furocoumarin, forms a complex with calf thymus DNA. The thermodynamics and kinetics of this process were studied. Analyzing the binding of HMT to DNA in buffers varying over a range of sodium ion concentrations showed that HMT binds to DNA by intercalation. Studying the binding by temperature-jump techniques led to a sequential binding model. HMT undergoes photochemical reactions when irradiated with uv light. Investigations into the aqueous photochemistry of HMT revealed three principal products: two dimers formed by cycloaddition and one photoisomerized form of HMT.

23109 **(ORNL/EIS—163-Vol.6-Pt.2) Chemicals identified in human biological media, a data base. Fifth annual report, October 1983, Volume VI, Part 2.** Cone, M.V.; Baldauf, M.F.; Opresko, D.M.; Uziel, M.S.; Chilton, B. (comps.). (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 488p. (EPA—560/5-83-012-Vol.6-Pt.2). NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE85008767.

A comprehensive data base of chemicals identified in human biological media (tissues and body fluids) has been established under the direction of the Environmental Protection Agency's Office of Toxic Substances Exposure Evaluation Division. This centralized resource of body-burden information was inspired by the concern of government scientists over continuing reports of toxic chemicals in human tissues and body fluids. Data were obtained primarily from the open literature through manual searches of selected journals. The file contains information on over 1000

chemicals that have been found in human biological media. Part 2 contains body burden data extracted since the last publication of the data base.

23110 **Translation of adenovirus 2 late mRNAs microinjected into cultured African green monkey kidney cells.** Richardson, W.D.; Anderson, C.W. (National Inst. of Child Health and Human Development, Bethesda, MD). *Journal of Virology;* **51**: No. 2, 559-562(Aug 1984).

Adenovirus 2-infected monkey cells fail to synthesize fiber, a 62,000 M/sub r/ virion polypeptide expressed at late times in productively infected cells. Yet these cells contain fiber mRNA that, after isolation, can be translated in vitro. The reason for the failure of monkey cells to translate fiber mRNA has been approached by microinjecting adenovirus mRNA into the cytoplasm of cultured monkey cells. Late adenovirus 2 mRNA, isolated from infected HeLa cells, was efficiently expressed when microinjected into the African green monkey kidney cell line CV-C. Expressed viral proteins identified by immunoprecipitation included the adenovirus fiber polypeptide. This result demonstrates that the monkey cell translational apparatus is capable of recognizing and expressing functional adenovirus mRNA. Microinjection of late virus mRNA into cells previously infected with wild-type adenovirus 2 failed to increase significantly the yield of infectious virus. 26 references, 2 figures, 1 table.

23111 **Topography of the O_2-evolving site determined with water analogs.** Radmer, R.; Ollinger, O. (Martin Marietta Labs., Baltimore, MD). *FEBS (Federation of European Biochemical Societies) Letters;* **152**: No. 1, 39-43(Feb 1983). Contract AC02-82ER12015.

Hydroxylamine (NH_2OH) and hydrazine (NH_2NH_2) are both analogs of two molecules of H_2O. As such, they appear to be competitive inhibitors of photosystem II-mediated H_2O oxidation: at low concentrations they are able to override H_2O oxidation without destroying the O_2-evolving system. The authors describe experiments in which they compared the donor activities of various substituted NH_2OH and NH_2NH_2 compounds with the ability of these same donors to interact with the intact O_2-evolving system. The ability of the compound to act as a donor was determined by monitoring fluorescence rise curves in Tris-extracted chloroplasts as a function of donor concentration. Interaction with the O_2-evolving system was determined from the concentration dependence of the delay in the maximum O_2 flash yield. Our results showed that the ability of a given donor to interact with the intact O_2-evolving system correlates with the shape of the molecule rather than its donor activity.

23112 **Regulation of Na, K-ATPase by its biosynthesis and turnover.** Karin, N.J.; Cook, J.S. (Univ. of Tennessee, Oak Ridge). *Current Topics in Membranes and Transport;* **19**: 713-751(1983). Contract W-7405-ENG-26.

The regulation of alkali cation transport in a cell or tissue is in general brought about by the interaction of two processes: modulation of the number of copies of Na, K-ATPase and modulation of the cativity of existing copies by appropriate ligands and substrates. An overview is presented in an attempt to address how many copies there are of Na, K-ATPase and what factors influence this number. Studies are reviewed on biosynthesis and degradation of the enzyme, and work in the fields of development and differentiation, endocrinology, cell cycle kinetics, tissue culture systems, as well as whole animal physiology. 123 references.

23113 **Circular dichroism and ordered structure of bisnucleoside oligophosphates and their Zn^{2+} and Mg^{2+} complexes.** Holler, E.; Holmquist, B.; Vallee, B.L.; Taneja, K.; Zamecnik, P. (Universitaet Regensburg, West Germany). *Biochemistry;* **22**: No. 21, 4924-4933(1983). Contract AC02-80EV10326.

Circular dichroism, absorbance, hypochromicity, and the formation of Mg^{2+} and Zn^{2+} complexes have been measured for a series of bisnucleoside oligophosphates that contain adenosine, guanosine, and mixed guanosine/adenosine, guanosine/cytidine, and guanosine/uridine, as well as 7-methylguanosine and ribose-methylated purine nucleosides. All of the metal complex ions have stacking interactions at 2 °C 10 mM tris(hydroxymethyl)aminomethane hydrochloride, pH 8.0. The effect of 7-methylation of guanosine is interpreted as causing a switch of nucleic acid base stacking from an atypical to a typical mode, which could be important for cap function in mRNA. The Mg^{2+} and Zn^{2+} complexes give rise to characteristic circular dichroism. In all instances excepting 7-methylated bisguanosine oligophosphates, the active secondary structures are disrupted, and in this regard, Zn^{2+} is more effective than Mg^{2+}. At least two sets of binding sites are involved. Stability, in terms of equilibrium constants, increases by more than 1000-fold as a function of chain length varying from two to six phosphates. The consequences of methylation are only minor. Electrostatic attraction between metal ions and phosphates is the most likely mechanism of these phenomena as judged by the effect of high ionic strength.

23114 **Reaction of β-propiolactone with derivatives of adenine and with DNA.** Chen, R.; Mieyal, J.J.; Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH). *Carcinogenesis (New York);* **2**: No. 2, 73-80(1982). Contract AC02-76EV02725.

The reaction of deoxyadenosine with β-propiolactone produces two derivatives. One is 1-(2-carboxyethyl)-2-deoxyadenosine (CEdA). The proposed structure for the other is 3-(β-D-2-deoxyribosyl)-7,8-dihydropyrimido-[2,1-i]purine-9-one (dDPP). Spectral characteristics of both compounds are presented. These include u.v. spectra of each in acidic, neutral and alkaline solutions, i.r. spectra, fluorescence spectra, and n.m.r. spectra. The dDPP can be converted to CEdA by mild acid hydrolysis, and the CEdA can be converted to dDPP by reaction with a carbodiimide derivative. When poly A was reacted with β-propiolactone, the yield of dDPP in the polymer was 7-9%. When double-stranded DNA was alkylated by [^{3}H]β-propiolactone at relatively high concentrations and then acid hydrolyzed to separate 1-(2-carboxyethyl)adenine (CEA) and 7-(2-carboxyethyl)guanine (CEG), and CEA to CEG ratio of up to 0.62 was obtained. With relatively low concentrations of [^{3}H]β-propiolactone, the yield of CEA was low with double-stranded DNA but was 5-6 fold greater with single-stranded DNA.

23115 **Kinetics for exchange of imino protons in the d(C-G-C-G-A-A-T-T-C-G-C-G) double helix and in two similar helices that contain a G x T base pair, d(C-G-T-G-A-A-T-T-C-G-C-G), and an extra adenine, d(C-G-C-A-G-A-A-T-T-C-G-C-G).** Pardi, A.; Morden, K.M.; Patel, D.J.; Tinoco, I. Jr. (Univ. of California, Berkeley). *Biochemistry;* **24**: No. 25, 6567-6574(1982). Contract AC03-76SF00098.

The relaxation lifetimes of imino protons from individual base pairs were measured in (I) a perfect helix, d(C-G-C-G-A-T-T-C-G-C-G), (II) this helix with a G x C base pair replaced with a G x T base pair, d(C-G-T-G-A-A-T-T-C-G-C-G), and (III) the perfect helix with an extra adenine base in a mismatch, d(C-G-C-A-G-A-A-T-T-C-G-C-G). The lifetimes were measured by saturation recovery proton nuclear magnetic resonance experiments performed on the imino protons of these duplexes. The measured lifetimes of the imino protons were shown to correspond to chemical exchange lifetimes at higher temperatures and spin-lattice relaxation times at lower temperatures. Comparison of the lifetimes in these duplexes showed that the destabilizing effect of the G x T base pair in II affected the opening rate of only the nearest-neighbor base pairs. For helix III, the extra adenine affected the opening rates of all the base pairs in the helix and thus was a larger perturbation for opening of the base pairs than the G x T base pair. The temperature dependence of the exchange rates of the imino proton in the perfect helix gives values of 14-15 kcal/mol for activation energies of A x T imino protons. The effects of a perturbation in helix on the exchange rates and the mechanisms for exchange of imino protons from oligonucleotide helices are discussed.

23116 **Biochemistry of dissimilatory sulfate reduction.** Peck, H.D. Jr.; LeGall, J. (Univ. of Georgia, Athens). *Philosophical Transactions of the Royal Society of London;* **B298**: 443-466(1982). Contract AS09-79ER10499.

Extensive information is available on the enzymology of respiratory sulfate reduction and the structure of electron transfer proteins isolated from the sulfate-reducing bacteria; however, it has not yet been possible to delineate satisfactorily the function of these

electron transfer proteins in terms of the enzymes involved in respiratory sulfate reduction. New information about differences in pyrophosphate metabolism by Desulfovibrio and Desulfotomaculum, celular localizations of electron transfer proteins and enzymes, and the concepts of vectorial electron transfer proteins must be re-evaluated and new experimental approaches designed before the problem is resolved. New information on the enzymology of lactate dehydrogenase, pyruvate dehydrogenase, adenylyl sulfate reductase, bisulfite reductase and hydrogenase is presented and discussed in the context of enzyme localization and specifically for electron transfer proteins. The function of cytochrome c_3 in the mechanism of the periplasmic hydrogenase and the role of the new non-haem iron centres in electron transfer is emphasized.

23117 **Two DNA glycosylases in Escherichia coli which release primarily 3-methyladenine.** Thomas, L.; Yang, C.; Goldthwait, D.A. (Case Western Reserve Univ. School of Medicine, Cleveland, OH). *Biochemistry;* **21**: 1162-1169(1982).

Two enzymes have been partially purified from Escherichia coli and designated 3-methyladenine DNA glycosylases I and II. The apparent molecular weight of glycosylase I is 20,000, and that of II is 27,000. Glycosylase I releases 3-methyladenine (3-MeA) while II releases 3-MeA, 3-methylguanine (3-MeG), 7-methylguanine (7-MeG), and 7-methyladenine (7-MeA). The rate of release of 3-MeA by glycosylase II is 30 times that of 7-MeG. Glycosylase I is missing in mutants tag 1 and tag 2. In crude extracts, the 3-MeA activity of II is approximately 10% of the total 3-MeA activity. A 50% inactivation at 48°C required 5 min for I and 65 min for II. The 3-MeA and 7-MeG activities of the glycosylase II preparation could not be separated by isoelectric focusing, by chromatography of DEAE, Sephadex G-100, phosphocellulose, DNA-cellulose, or carboxymethylcellulose, or by heating at 50°C.

23118 **Enzymatic excision of 3-methyladenine and 7-methylguanine by a rat liver nuclear fraction.** Cathcart, R.; Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH). *Biochemistry;* **20**: No. 2, 273-280(1981). Contract AC02-76EV02725.

A 3-methyladenine-DNA N-glycosylase was identified in both nuclear and cytoplasmic extracts of rat liver. The enzyme was purified from nuclei due to a lower level of nonspecific nucleases. The enzyme was purified 100-fold by using DNA-cellulose and phosphocellulose chromatography. Several methods of assay were developed and are discussed. The molecular weight of the glycosylase was 24000. It exhibited a preference for double-stranded alkylated DNA. The apparent K/sub m/ for 3-methyladenine residues was 2.6 nM. The enzyme was shown to be a glycosylase by the stoichiometric release of 3-methyladenine and the appearance of alkali-sensitive sites. There was no endonucleolytic activity on double-stranded DNA, depurinated DNA, UV-treated DNA, or γ-irradiated DNA. The relative rate of release of 3-methyladenine and 7-methylguanine was the same for both the DNA-cellulose and phosphocellulose fractions, and both activities were inactivated by heat to the same extent. Whether one or two enzymes are involved is not known. The preparation does not release 3-methylguanine or 1-methyladenine.

5503 Cytology

23119 **(CONF-8503125—1) Meiotic process and aneuploidy.** Grell, R.F. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009295.

From Symposium on aneuploidy: etiology and mechanisms; Washington, DC, USA (25 Mar 1985).

The process of meiosis is analyzed by dissecting it into its component parts using the early oocyte of Drosophila as a model. Entrance of the oocytes into premeiotic interphase signals initiation of DNA replication which continues for 30 h. Coincidentally, extensive synaptonemal complexes appear, averaging 50 μm (132 h), peaking at 75 μm (144 h) and continuing into early vitellarial stages. Recombinational response to heat, evidenced by enhancement or induction of exchange, is limited to the S-phase with a peak at 144 h coinciding with maximal extension of the SC. Coincidence of synapsis and recombination response with S at premeiotic interphase is contrary to their conventional localization at meiotic prophase. The interrelationship between exchange and nondisjunction has been clarified by the Distributive Pairing Model of meiosis. Originally revealed through high frequencies of nonrandom assortment of nonhomologous chromosomes, distributive pairing has been shown to follow and to be noncompetitive with exchange, to be based on size-recognition, not homology, and as a raison d'etre, to provide a segregational mechanism for noncrossover homologues. Rearrangements, recombination mutants and aneuploids may contribute noncrossover chromosomes to the distributive pool and so promote the nonhomologous associations responsible for nondisjunction of homologues and regular segregation of nonhomologues. 38 references, 15 figures. (ACR)

23120 **Early origin and pervasiveness of cellular heterogeneity in some malignant transformations.** Rubin, H. (Univ. of California, Berkeley). *Proceedings of the National Academy of Sciences of the United States of America;* **81**: No. 16, 5121-5125(Aug 1984). Contract AT03-79EV10277.

Nontransformed BALB/3T3 cells were passaged weekly in monolayer culture on plastic dishes and aliquots were regularly assayed for colony production when suspended in agar. During several months of passaging, a single large colony arose once in the agar assay, and its constituent cells were isolated to form a subline of transformed cells. These cells had the fusiform and rounded morphologies characteristic of transformed cells and had a colony-forming efficiency in agar (CFEag) of $\approx$ 10%. Five of the agar colonies were isolated at random and the cell populations of these primary subclones were further analyzed. Four of the five subclonal populations differed from each other in appearance slightly, but consistently, while the fifth had a markedly different colonial morphology. They also differed from one another in CFEag as well as in average diameter of the agar colonies. All of the subclones produced sarcomas in nude mice but did so at different rates. A secondary generation of five subclones was derived from each of three of the original subclonal populations. All the secondary subclones had the same morphology as the primary subclones from which they were derived. The averages of the CFEag and colony sizes of the secondary subclones from each of the subclones differed as a group from the other groups, but they also differed, to a lesser extent, among themselves. Despite the differences noted among the primary subclones in morphology, growth in agar, and tumor production in mice, they were virtually identical in their rapid growth rate on a plastic surface and all shared a high rate of glucose consumption. 32 references, 6 figures.

23121 **Changes in cell shape correlate with collagenase gene expression in rabbit synovial fibroblasts.** Aggeler, J.; Frisch, S.M.; Werb, Z. (Univ. of California, San Francisco). *Journal of Cell Biology;* **98**: No. 5, 1662-1671(May 1984). Contract AC03-76SF01012.

Induction of the neutral proteinase, collagenase, is a marker for a specific switch in gene expression observed in rabbit synovial fibroblasts. A variety of agents, including 12-O-tetradecanolyphorbol-13-acetate, cytochalasins B and D, trypsin, chymotrypsin, poly(2-hydroxyethylmethacrylate), and trifluorperazine induced this change in gene expression. Induction of collagenase by these agents was always correlated with a marked alteration in cell morphology, although the cells remained adherent to the culture dishes. The amount of collagenase induced was positively correlated with the degree of shape change produced by a given concentration, and, to some extent, with the duration of treatment. Altered cell morphology was required only during the first few hours of treatment with inducing agents after this time. Collagenase synthesis continued for up to 6 d even when agents were removed and normal flattened cell morphology was regained. All agents that altered cell morphology also produced a characteristic switch in protein secretion phenotype, characterized by the induction of procollagenase (M/sub r/ 53,000 and 57,000) and a neutral metalloproteinase (M/sub r/ 51,000), which accounted for approximately 25% and 15% of the protein secreted, respectively. Secretion of another neutral proteinase, plasminogen activator, did not correlate with increased collagenase secretion. In contrast, synthesis and secretion of a number of other polypeptides, including the extracellular matrix proteins, collagen and fibronectin, were concomitantly decreased. 56 references, 8 figures, 4 tables.

5504 Genetics

23122 Generation of deletions in pneumococcal mal genes cloned in Bacillus subtilis. Lopez, P.; Espinosa, M.; Greenberg, B.; Lacks, S.A. (Brookhaven National Lab., Upton, NY). *Proceedings of the National Academy of Sciences of the United States of America;* **81**: No. 16, 5189-5193(Aug 1984).

The pneumococcal recombinant plasmid pLS70, which contains two strong promoters for transcription of the malM and MalX genes, is unstable when transferred to Bacillus subtilis, and it gives rise to deleted derivatives. Analysis of proteins produced by the deleted plasmids and restriction mapping of 29 different deletions showed that stablization in B. subtilis was accompanied by deletions affecting both promoters. Plasmids containing even a single strong promoter were at a selective disadvantage. Nucleotide sequences surrounding the deletions in 10 plasmids were determined. Six different deletions occurred between directly repeated sequences of 3-13 base pairs in length, presumably by a recombination mechanism involving short homologies. Four deletions occurred between sites not contained within repeated sequences. A weak but significant similarity of an 11-base sequence was found surrounding these deletions and the corresponding points of junction in the progenitor plasmids. It is suggested that this sequence may be the recognition site for a topoisomerase-like enzyme that can produce deletions. 26 references, 6 figures.

5505 Metabolism

23123 Membrane protein damage and repair: removal and replacement of inactivated 32-kilodalton polypeptides in chloroplast membranes. Ohad, I.; Kyle, D.J.; Arntzen, C.J. (Michigan State Univ., East Lansing). *Journal of Cell Biology;* **99**: No. 2, 481-485(Aug 1984). Contract AC02-76ER01338.

Incubation of Chlamydomonas reinhardii cells at light levels that are several times more intense than those at which the cells were grown results in a loss of photosystem II function (termed photoinhibition). The loss of activity corresponded to the disappearance from the chloroplast membranes of a lysine-deficient, herbicide-binding protein of 32,000 daltons which is thought to be the apoprotein of the secondary quinone electron acceptor of photosystem II (the Q/sub B/ protein). In vivo recovery from the damage only occurred following de novo synthesis (replacement) of the chloroplast-encoded Q/sub B/ protein. We believe that the turnover of this protein is a normal consequence of its enzymatic function in vivo and is a physiological process that is necessary to maintain the photosynthetic integrity of the thylakoid membrane. Photoinhibition occurs when the rate of inactivation and subsequent removal exceeds the rate of resynthesis of the Q/sub B/ protein. 22 references, 5 figures.

5506 Medicine

REFER ALSO TO CITATION(S) 55060023045, 23139

23124 (AD-A—149115/8/XAB) Use of a radiotherapy treatment-planning computer for dosimetry of the AFRRI (Armed Forces Radiobiology Research Institute) Cobalt-60 Facility. Technical report. Zeman, G.H.; Dooley, M.A.; Working, K. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Dec 1984. 15p. NTIS, PC A02/MF A01.

This study examined the feasibility of using radiation therapy treatment-planning computer (TPC) designed for clinical radiotherapy, to calculate patterns of depth dose and tissue-to-air ratios (TAR's) for objects irradiated in the Cobalt-60 Facility at the Armed Forces Radiobiology Research Institute (AFRRI). The TPC was used to calculate patterns of depth dose for four cylindrical phantoms of different sizes. Patterns of whole-body depth dose and TAR's were calculated for cylindrical phantoms using a computer for treatment planning, and then compared to those measured in the Cobalt-60 Facility. The measured TAR's agreed well with the computer-calculated TAR's for one computational mode but not for another. The calculated and experimental depth-dose patterns agreed well at the central cross sections of the phantoms, but differed significantly at the cross sections near the end of the phantoms. These data demonstrate the degree of nonuniformity of dose in cylindrical phantoms irradiated in the Cobalt-60 Facility. They also point out the usefulness of a treatment-planning computer in characterizing distributions of depth dose.

23125 (CONF-850164—1) Hospital-based proton medical accelerator. Martin, R. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007953.

From FNAL/ANL workshop on charged particle accelerators for cancer therapy; Batavia, IL, USA (24 Jan 1985).

The design of a medical accelerator producing 250 MeV proton beams is described and discussed. Emphasis is placed on minimizing construction and operating costs. 6 figures. (ACR)

23126 (CONF-850166—1) New technologies to improve laboratory testing. Burtis, C.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008151.

From 8. annual Arnold O. Beckman conference in clinical chemistry; San Diego, CA, USA (28 Jan 1985).

Several core technologies that are having, or will have, an impact on the clinical laboratory are discussed. These include instrument-related technologies such as computer technology, chemometrics, robotics, sensors, and biological technologies such as cell fusion and recombinant DNA. 79 references, 14 figures. (ACR)

23127 (DOE/ER/10275—1B, pp 53) **Prompt Gamma Neutron Activation Computerized Tomography (PGNACT).** Ikoro, N.C. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The utilization of neutron activation technique for various non-destructive studies is of ever increasing demand. This paper discusses the potential for prompt gamma neutron computerized tomography. This may provide a foundation for the development of a non-destructive system which can quantitate the elemental content of an object's substructure.

23128 (DOE/ER/10275—1B, pp 54) **Radiation induced changes in NMR relaxation times of tissue protons.** Achtemeier, L.K. Kennedy, W.L. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

An exciting development in the field of imaging is the possibility of using nuclear magnetic resonance (NMR) to discriminate between different tissues. It has already been shown that the spin-lattice(T_1) and spin-spin(T_2) relaxation times are very different for tumor tissue compared with normal tissue. At UMC research is currently underway to investigate the changes in T_1 and T_2 due to neutron radiation damage. Early findings show a reduction in the T_2 compared with normal tissue. NMR will become an invaluable diagnostic tool in the clinical setting when the variations in relaxation times with dose are documented.

23129 (DOE/ER/10275—1B, pp 56) **Current techniques in mammography.** Bohm, B. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

This paper represents a literature survey of current techniques in mammography. The major objection to the otherwise acceptable methods in widespread use are the radiation doses given the patient, particularly the asymptomatic patient. Even using current techniques which involve x-raying the breast, all women over 50 should have yearly exams for the earliest possible cancer detection and hence improved diagnosis. It is for asymptomatic women under 50 that the risk versus benefit issue becomes controversial. Strong efforts are being made to reduce or eliminate this dose. Cur-

rent methods in widespread clinical use and experimental methods are briefly covered, and the recommendations of the National Council on Radiation Protection and Measurements (released July 1980) are stressed. The current experimental techniques which include NMR, ultrasound, thermography, computer tomography, heavy particle radiography and ionography are capsulized.

23130 (DOE/ER/10275—1B, pp 57) **Gamma transmission tomography.** Pottruff, J.E. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The potential for simultaneous neutron and gamma ray tomographic imaging of biological materials has been demonstrated using an Iron Filtered neutron beam at the University of Missouri Research Reactor (MURR). A Bismuth Germanate scintillation detector was placed behind a borated polyethylene neutron shield, so as to utilize the transmitted gamma rays with minimal neutron contamination. This experimental set up employed a gamma ray energy region of 0.80 to 2.5 MeV in order to contrast gamma ray transmission intensities between tissue and bone-simulated materials. An aluminum phantom placed in water was effectively imaged.

23131 (LA-UR—85-802) **Flow cytometry for health monitoring in space.** Jett, J.H.; Martin, J.C.; Saunders, G.C.; Stewart, C.C. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 26p. (CONF-8410230—11). NTIS, PC A03/MF A01; GPO Dep. File Number DE85009572.

From Lunar bases and space activities of the 21st century; Washington, DC, USA (29 Oct 1984).

Monitoring the health of space station or lunar base residents will be necessary to provide knowledge of the physiological status of astronauts. Flow cytometric techniques are uniquely capable of providing cellular, chromosome, hormone level and enzyme level information. The use of dyes provides the basis for fluorescently labeling specific cellular components. Laser induced fluorescence from stained cells is quantitated in a flow cytometer to measure cellular components such as DNA, RNA and protein. One major application of a flow cytometer will be to perform a complete blood count including hematocrit, hemoglobin content, and numbers of platelets, erythrocytes, granulocytes, lymphocytes and monocytes. A newly developed flow cytometry based fluoroimmunoassay will be able to measure levels of serum enzymes and hormones. It will also be possible to quantitate radiation exposure and some forms of chromosome damage with flow cytometric measurements. With relatively simple modifications to existing technology, it will be possible to construct a flight rated cytometer. 11 references, 6 figures, 2 tables.

23132 (PB—84-922808/XAB) **Postoperative adjuvant therapy of breast cancer. Oncology Overview.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). Dec 1984. 64p. (NCI/ICRDB/OT—84/08). NTIS, PC $8.00.

Oncology Overviews are a service of the International Cancer Research Data Bank (ICRDB) Program of the National Cancer Institute, intended to facilitate and promote the exchange of information between cancer scientists by keeping them aware of literature related to their research being published by other laboratories throughout the world. Each Oncology Overview represents a survey of the literature associated with a selected area of cancer research. It contains abstracts of articles which have been selected and organized by researchers associated with the field. Contents: Postoperative chemotherapy; Postoperative radiotherapy; Postoperative hormone therapy; Postoperative immunotherapy and chemoimmunotherapy; Postoperative multimodal therapy; Prognostic factors in postoperative adjuvant therapy.

23133 (PB—85-145720/XAB) **Recommendations for quality assurance programs in nuclear medicine facilities. Radiation recommendations series.** Segal, P.; Hamilton, D.R. (Food and Drug Administration, Rockville, MD (USA). Center for Devices and Radiological Health). Oct 1984. 28p. NTIS, PC A03/MF A01.

The publication provides the elements that should be considered by nuclear medicine facilities to improve their existing programs or develop new quality assurance programs. The important administrative aspects of quality assurance programs are stressed. Each facility is encouraged to adopt those elements of the recommended program that are appropriate to its individual needs and resources.

23134 (PB—85-146132/XAB) **Routine compliance testing for head and neck radiographic systems. Part 11.** (Food and Drug Administration, Rockville, MD (USA). Center for Devices and Radiological Health). 30 Jun 1984. 32p. NTIS, PC A03/MF A01.

See also PB84-190958.

The report is intended as a supplement to Report FDA 84-8225, Routine Compliance Testing for Diagnostic X-Ray Systems, and covers test procedures for head and neck radiographic systems. These procedures will be used for screening those systems for evidence of noncompliance with the performance standard. It is important that this supplement be made available to anyone concerned with compliance testing procedures for diagnostic x-ray systems, since this is a new procedure and, hence, not part of the original report.

5507 Microbiology

REFER ALSO TO CITATION(S) 55070022491, 23116, 23117, 23122

23135 (DOE/ER/12095—1) **[Regulation of alcohol fermentation by Escherichia coli]. Progress report.** Clark, D.P. (Southern Illinois Univ., Carbondale (USA)). [1985]. Contract AC02-82ER12095. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009726.

Constitutive adhC mutants were used as a starting point for the isolation of further mutants, some of which are defective in alcohol dehydrogenase (ADH) and/or acetaldehyde dehydrogenase (ACDH) activities and some of which are regulatory and express elevated enzyme levels. The structural mutants map close to the adhC gene, suggesting the existence of an anaerobically controlled operon responsible for the conversion of acetyl-CoA to ethanol. Purification of the two enzyme activities indicates that both copurify as a complex of approximately 200,000 daltons. Although confirmation is required, both enzyme activities appear to be functions of a single polypeptide of MW 100,000 daltons. This interpretation is consistent with genetic data which show that most mutants selected directly for loss of either enzyme have also lost the other activity. Temperature sensitive mutants in which both enzymes are thermolabile also support the idea of a single polypeptide for the two activities. Regulatory mutants located away from the adhC locus have been isolated, and result in two to tenfold elevation of both ADH and ACDH. These mutants are in process of further characterization. Study of adh regulation by means of gene fusions has been slowed by technical problems, however we have devised a direct method for the selection of mutants unable to excrete acidic fermentation products and have accumulated a variety of anaerobically regulated gene fusions which have allowed us to estimate that anaerobiosis in E. coli requires the induction of around 50 genes.

23136 **Sphaeroplast formation and regeneration in Trichoderma reesei.** Picataggio, S.K.; Schamhart, D.H.J.; Montenecourt, B.S.; Eveleigh, D.E. (Cook Coll., New Brunswick, NJ). *European Journal of Applied Microbiology and Biotechnology;* **17**: 121-128(1983). Contract AC02-83ER13106.

Sphaeroplasts from several genetically marked strains of Trichoderma reesei were readily prepared through enzymatic hydrolysis of mycelial suspensions utilizing Driselase, a commercially available lytic enzyme preparation. The efficiency of sphaeroplast formation was dependent upon a number of factors. Young mycelium was far more susceptible to lysis than older hyphae. Additionally, the yields of sphaeroplasts were directly proportional to the mycelial concentration within the range tested. The combined application of Driselase and chitinase (Streptomyces griseus) to mycelial suspensions resulted in increased sphaeroplast yields from young (18 h) as well as older (24 h) mycelia. The parameters defined here allow the rapid, inexpensive production of 10^7 sphaeroplasts/ml.

Regeneration of T. reesei sphaeroplasts proceeded by the production of chains of sphaeroplast-like cells followed by true hyphal formation. The frequency of regeneration to mycelial form was dependent upon the length of exposure of mycelium to the lytic enzyme.

5510 Physiological Systems

23137 **(PB—85-142727/XAB) Tests of the application of the radioactive microsphere technique to the measurement of regional myocardial blood flow.** King, R.B.; Bassingthwaighte, J.B. (Washington Univ., Seattle (USA). Center for Bioengineering). Dec 1984. 14p. NTIS, PC A02/MF A01.

The radioactive microsphere technique is tested for its applicability to the measurement of regional myocardial blood flow in the conscious baboon. Tests undertaken were: (1) the reproducibility of microsphere deposition densities, (2) recirculation of microspheres, (3) the effects of microsphere size and injection site on local microsphere depositions, (4) comparison of temporally separated injections, and (5) the effects of the statistics of microsphere distribution and of the fineness of piece-mealing on the apparent dispersion of local flows.

5530 Agriculture And Food Technology

23138 **Nitrogen fixation apparatus.** Chen, H.L. (to Dept. of Energy). US Patent 4,482,525. 13 Nov 1984. Filed date 21 Apr 1983. vp.

PAT-APPL-487491.

A method and apparatus for achieving nitrogen fixation includes a volumetric electric discharge chamber. The volumetric discharge chamber provides an even distribution of an electron beam, and enables the chamber to be maintained at a controlled energy to pressure (E/p) ratio. An E/p ratio of from 5 to 15 kV/atm of O_2/cm promotes the formation of vibrationally excited N_2. Atomic oxygen interacts with vibrationally excited N_2 at a much quicker rate than unexcited N_2, greatly improving the rate at which NO is formed.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 56012023154

23139 **(AD-A—147778/5/XAB) AFRRI (Armed Forces Radiobiology Research Institute) annual research report, 1 October 1982-30 September 1983.** (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 30 Sep 1983. 192p. (AFRRI-ARR—17). NTIS, PC A09/MF A01.

This report contains a summary of the research projects of the Armed Forces Radiobiology Research Institute for the period 1 October 1982 through 30 September 1983.

23140 **(AD-A—149284/2/XAB) Behavior degradation due to 1100-rad pulsed radiation exposure (5.8:1 neutron/gamma ratio). Final report, June-December 1982.** Brown, G.C.; Yochmowitz, M.G.; Hubbard, G.B.; Hardy, K.A.; Hughes, D.M. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Oct 1984. 60p. NTIS, PC A04/MF A01.

A self-paced, 3-light, 3-lever discrete avoidance behavioral task was used for further study of behavioral performance effects of a high-neutron, low-gamma radiation pulse exposure (average 1100 rads midline tissue, 5,8:1 neutron/gamma ratio). Eight rhesus monkeys were exposed at the White Sands Missile Range Fast Burst Reactor and tested daily for up to 5 days after exposure. On the exposure day, all eight subjects had significantly degraded response accuracy, seven had increased reaction-time scores, seven experienced productive emesis. One day after exposure, most subjects performed near baseline levels except for occasional brief period(s). At 2 days, two subjects were unable to meaningfully perform the behavioral task and were euthanatized. The other six subjects were more variable than on the previous day. Three subjects experienced additional emetic episodes. At 5 days, only two of the remaining four animals performed at any reasonable degree. It is unlikely that any animal could have performed on the sixth day.

23141 **(AD-A—149534/0/XAB) Laser Hazards Bibliography - October 1984.** Sliney, D.H.; Galoff, P.K.; Wood, R.L.; Wood, S. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)). 31 Oct 1984. 207p. NTIS, PC A10/MF A01.

Supersedes report dated August 1983.

The Laser Hazards Bibliography consists of 2,795 references in the open literature broken into subject categories which relate to general biological effects, the eye, the skin, laser safety, laser propagation in the atmosphere, and laser measurements.

23142 **(CONF-830220—2) Multi-hit Weigle-reactivation of uv-phage lambda in a fraction of complexes with uv-E. coli K12.** Fluke, D.J.; Bronner, C.E.; Pollard, E.C. (Duke Univ., Durham, NC (USA). Dept. of Zoology). 1983. Contract AS05-76EV03631. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009645.

From 31. annual meeting of the Radiation Research Society - epidemiology of irradiated human populations; San Antonio, TX, USA (27 Feb 1983).

While W-reactivation plaque survival curves conform reasonably well to dose-modifying factors through most of the lower range in plaque survival, substantial departures from a DMF description occur in the first decade of plaque survival. For 265-nm uv lambda in 265-nm uv E. coli AB1157 we have reported results consistent with 5 to 7 hits repaired in about 15% of complexes at maximum, with single-hit plaque survival at the same D_0 in the other 85%. Subsequent extension of these results over five decades of plaque survival show, at maximum W-reactivation, a 5-hit repair in 19% of the complexes, with a consistent D_0 throughout, about 13.4 J/m^2. Graded induction of the cells primarily changes the fraction of complexes giving the W-reactivation, and the maximum fraction is substantially independent of cell growth stage. At maximum W-reactivation, induced cells incubated post-uv showed some decline in the number of hits repairable, rather more decline in the fraction of complexes giving the W-reactivation, while holding fairly steady in D_0. The further studies also indicate that the process conforms very well to multi-hit target theory, although two other shouldered-curve models give fairly similar numerical results. 3 figures, 2 tables.

23143 **(CONF-8306264—1) Rifampin-stimulated uv resistance of phage λ on Escherichia coli K12.** Bronner, C.E.; Fluke, D.J.; Pollard, E.C. (Duke Univ., Durham, NC (USA). Dept. of Zoology). 1983. Contract AS05-76EV03631. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008551.

From 11. annual meeting of the American Society for Photobiology; Madison, WI, USA (26 Jun 1983).

The plaque survival of uv-irradiated phage λ on excision-proficient E.coli strain AB1157 is greater if the host cells are exposed to rifampin for 10 minutes prior to infection. This repair is accompanied by little or no clear-plaque mutagenesis. Host cells uv-irradiated and incubated for 30 minutes in growth medium prior to treatment with rifampin show some Weigle-reactivation in addition to the repair stimulated by rifampin. Some clear-plaque Weigle-mutagenesis is also observed in the presence of rifampin: however, the amount is less than that seen in the absence of rifampin treatment. In contrast, the uv sensitivity of λ on strain AB1886, an excision-repair deficient mutant, is unchanged by pre-treating the cells with rifampin, and no Weigle-reactivation is observed. These results suggest that repair of λ on unirradiated cells in the presence of rifampin is an excision-dependent, error-free phenomenon. Since initiation of replication of λ DNA requires RNA polymerase, and since rifampin blocks transcription by that polymerase, the effect of rifampin on the survival of λ may be to delay phage replication, thereby allowing more time for excision repair to operate. 6 figures.

23144 (CONF-8403123—2) Action spectrum for the induction of phage lambda in E. coli strain AB1886 by uv light. Fluke, D.J.; Pollard, E.C.; Bronner, C.E. (Duke Univ., Durham, NC (USA); Pennsylvania State Univ., University Park (USA)). 1984. Contract AS05-76EV03631. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008550.

From 32. annual scientific meeting of Radiation Research Society; Orlando, FL, USA (1 Mar 1984).

By observing a series of dose/response relationships at different wavelengths of ultraviolet light in comparison with a dose/response at predominantly 254 nm on the same day's culture, a series of comparative values for the effectiveness of ultraviolet light in inducing lambda, as seen by cell lysis, has been measured. The resulting action spectrum, in comparison with DNA absorption, is more effective between 270 and 290 nm than at 313 nm. 5 references, 3 figures.

23145 (DOE/ER/10275—1B, pp 32) Radiation exposure rate of aircraft passengers and crew members. Elam, J.A. (Tennessee Technological Univ., Cookeville). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

The amount of radiation exposure to passengers and crew members of aircraft was determined. Data were gathered from 15 pilots. They were issued film dosimeters sensitive to different ranges of energies. Research is discussed on the various results from altitude and latitude changes, solar cycle fluctuation, and nuclear testing. The exposures received are related to other fields that have radiation problems and then compared with previous research on high altitude aircraft.

23146 (DOE/ER/60110—2) Radiological Research Accelerator Facility. Progress report, April 1, 1984-March 31, 1985. Rossi, H.H. (Columbia Univ., Irvington-on-Hudson, NY (USA). Nevis Labs.). Jan 1985. Contract AC02-83ER60110. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85007062.

The aim of the Radiological Research Accelerator Facility (RARAF) was to provide a source of monoenergetic neutrons for studies in radiation biology, dosimetry and microdosimetry. The research has provided insight into the biological action of radiation and its relation to energy distribution in the cell as described by the theory of dual radiation action. This status report on the facility includes descriptions of the capabilities and layout, staffing, radiation safety, and a chronological account of the development and use of the facilities. 5 references, 2 figures. (ACR)

23147 (DOE/EV/03631—13-Pt.1) Radiation damage and repair in cells and cell components. Final report. Part 1. Fluke, D.J. (Duke Univ., Durham, NC (USA). Dept. of Zoology). 1984. Contract AS05-76EV03631. 19p. (ORO—3631-13-Pt.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008667.

An overview of research into the direct action of ionizing radiation, especially the effect of radiation temperature, primarily upon enzymes, into induced repair, and into S.O.S.-related phenomena, is presented. (ACR)

23148 (DOE/EV/03631—13-Pt.2-Rev.) Radiation damage and repair in cells and cell components. Part 2. Physical radiations and biological significance. Final report. Fluke, D.J. (Duke Univ., Durham, NC (USA). Dept. of Zoology). Aug 1984. Contract AS05-76EV03631. 95p. (ORO—3631-13-Pt.2-Rev.). NTIS, PC A05/MF A01; GPO Dep. File Number DE85008934.

The report comprises a teaching text, encompassing all physical radiations likely to be of biological interest, and the relevant biological effects and their significance. Topics include human radiobiology, delayed effects, radiation absorption in organisms, aqueous radiation chemistry, cell radiobiology, mutagenesis, and photobiology. (ACR)

23149 (DP-MS—84-116-Rev.12-84) Personal protective clothing. Revision. Zippler, D.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1984. Contract AC09-76SR00001. 12p. (CONF-8410245—1-Rev.). NTIS, PC A02/MF A01; GPO Dep. File Number DE85007908.

From Occupational health and safety symposium; Wilmington, DE, USA (3 Oct 1984).

The protective clothing used at the Savannah River Plant is briefly described. Materials, designs, and cost factors are discussed. 8 figures. (ACR)

23150 (ORNL—6156) Survey of international personnel radiation dosimetry programs. Swaja, R.E. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010138.

In September of 1983, a mail survey was conducted to determine the status of external personnel gamma and neutron radiation dosimetry programs at international agencies. A total of 130 agencies participated in this study including military, regulatory, university, hospital, laboratory, and utility facilities. Information concerning basic dosimeter types, calibration sources, calibration phantoms, corrections to dosimeter responses, evaluating agencies, dose equivalent reporting conventions, ranges of typical or expected dose equivalents, and degree of satisfaction with existing systems was obtained for the gamma and neutron personnel monitoring programs at responding agencies. Results of this survey indicate that to provide the best possible occupational radiation monitoring programs and to improve dosimetry accuracy in performance studies, facility dosimetrists, regulatory and standards agencies, and research laboratories must act within their areas of responsibility to become familiar with their radiation monitoring systems, establish common reporting guidelines and performance standards, and provide opportunities for dosimetry testing and evaluation. 14 references, 10 tables.

23151 (PNL—5415) Potential behavior of depleted uranium penetrators under shipping and bulk storage accident conditions. Mishima, J.; Parkhurst, M.A.; Scherpelz, R.I. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 138p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85009778.

An investigation of the potential hazard from airborne releases of depleted uranium (DU) from the Army's M829 munitions was conducted at the Pacific Northwest Laboratory. The study included: (1) assessing the characteristics of DU oxide from an April 1983 burn test, (2) postulating conditions of specific accident situations, and (3) reviewing laboratory and theoretical studies of oxidation and airborne transport of DU from accidents. Results of the experimental measurements of the DU oxides were combined with atmospheric transport models and lung and kidney exposure data to help establish reasonable exclusion boundaries to protect personnel and the public at an accident site. 121 references, 44 figures, 30 tables.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 56030022363, 23078, 23081, 23143, 23151

23152 (EPRI-EA—3920-Vol.2) Toxicology of fossil fuel combustion products. Volume 2. Clinical interpretation. Final report. Simmons, W.S. (Systems Applications, Inc., San Rafael, CA (USA)). Mar 1985. 315p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $25.00. File Number TI85920570.

This report covers the interim results of a 5 year program studying the effects of various air pollutants, both individually and combined, in a variety of test systems. Humans, several different animal species, and in vitro test systems are used. Additionally, several methodology advances in the measurement of pollutants and their effects determined in the test systems are covered. The pollutants covered include SO2, NOx, oxidants, sulfates, various particulates and mixtures of some of them. Volume I consists of extensive

summaries of the research, as well as tabular compilations of the principal results. Volume II consists of the responses of 20 clinical respiratory investigators to a detailed questionnaire about several of the studies, and their recommendations for further research. A summary of their responses is also included.

23153 **(PNL—5500-Pt.1) Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.** Felton, D.L. (ed.). (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85009365.

Research progress is reported in the following areas: (1) evaluation of possible health effects among nuclear workers; (2) dose-effect relationship studies of carcinogenesis from both nuclear materials and complex mixtures; (3) microbial mutagenesis studies with 6-aminochrysene and benzo[a]pyrene in coal-derived complex mixtures; and (4) a variety of studies relating to noncarcinogenic and nonmutagenic endpoints, including teratology, perinatal studies and studies to determine absorption, metabolism, and doses to critical tissues and organs of coal-derived mixtures and radionuclides. Items have been individually abstracted for the data base. (ACR)

23154 **(PNL—5500-Pt.4) Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 4. Physical sciences.** Danko, J.E. (ed.). (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 76p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009285.

Progress is reported in the following areas: (1) chemical basis for the biological response to complex organic mixtures; (2) supercritical fluid analytical methods; (3) lasers in analytical chemistry; (4) initial interaction processes in radiation physics; (5) track structure; (6) radiation dosimetry; (7) modeling and cellular studies; (8) radiation biophysics; (9) modeling cellular response to genetic damage; and (10) internal microdosimetry. (ACR)

23155 **(PNL-SA—11304) Correlating survival and DNA excision repair in human fibroblasts.** Miller, J.H.; Heflich, R.H. (Pacific Northwest Labs., Richland, WA (USA); National Center for Toxicological Research, Jefferson, AR (USA)). Jul 1983. Contract AC06-76RL01830. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008578.

A model is presented that correlates the survival of cells in tissue culture exposed to toxic agents with the rate of excision of residues bound to DNA. Under the assumptions of the model, data on the survival of normal human fibroblasts (NF) and fibroblasts from xeroderma pigmentosum (XP) patients in complementation groups A, C and E (XPA, XPC and XPE) after exposure to N-acetoxy-2-acetylaminofluorene (N-AcO-AAF) were used to predict the rate of excision of N-AcO-AAF-induced DNA residues by the partially repair deficient cells relative to the rate of excision by NF. These predictions were tested by measurements of the rate of removal of radiolabeled N-AcO-AAF-induced DNA residues by fibroblasts in confluent cultures. In general, XPE removed N-AcO-AAF-induced DNA residues at the rate predicted by the model while the rate of repair by XPC was slower than predicted. The results with XPC indicate that this cell strain not only has a reduced rate of DNA excision repair but also differs from NF in other factors that affect cell survival. 21 references, 2 figures.

23156 **(UCRL—90661) Berylliosis: a disease of the past.** Schweickert, G.L. (Lawrence Livermore National Lab., CA (USA)). 11 Feb 1985. Contract W-7405-ENG-48. 11p. (CONF-8410257—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85007930.

From Beryllium sub-working group meeting; Aldermaston, UK (1 Oct 1984).

The natural history of berylliosis remains a toxicological puzzle despite 40 years of investigation. In this paper, the author reviews current theories on the mechanisms of the disease, most of which are based on hypersensitivity of an individual's immune system to Be. He examines over-response as a critical factor using the update Be case registry, carcinogenicity evidence, and experimental animal data. And, comments are presented on the efficacy of industrial hygiene controls, implemented during the 1940's, that have reduced the incidence of beryllium-related disease in the US to nearly zero. 11 references, 2 figures, 1 table.

23157 **Characterization of diesel exhaust in a chronic inhalation study.** Cheng, Y.S.; Yeh, H.C.; Mauderly, J.L.; Mokler, B.V. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *American Industrial Hygiene Association Journal;* **45**: No. 8, 547-555(Aug 1984). Contract AC04-76EV01013.

The authors describe characterization of the exposure atmosphere in a life-span study of rats and mice exposed to chronic inhalation of diluted diesel exhaust. Diesel exhaust was generated by one of two General Motors 1980 Model, 5.7-liter V8 diesel engines connected to an eddy current dynamometer/flywheel system and operated on the Federal Test Procedure urban driving cycle. Animals were exposed 7 hours/day, 5 days/week to exhaust at particle concentrations of approximately 7000, 3500, and 350 $\mu g/m^3$ or to clean air. Throughout the 24-month study, the mean particle mass concentration remained within 5% of the target values. Measured gas concentrations of CO, CO_2, NO, NO_2, and hydrocarbons were roughly proportional to the dilution ratio. A combination of a Lovelace Multijet cascade impactor followed by a parallel flow diffusion battery gave mass median diameters of 0.23 to 0.26 μm averaged over complete cycles and geometric standard deviations larger than 4. The aerosol concentration profile was associated with the operating cycle. The measured diesel particle size was similar to previously reported values of particles released to the atmosphere from the same model engine. 30 references, 8 figures, 4 tables.

23158 **Membrane protein damage and repair: selective loss of a quinone-protein function in chloroplast membranes.** Kyle, D.J.; Ohad, I.; Arntzen, C.J. (Michigan State Univ., East Lansing). *Proceedings of the National Academy of Sciences of the United States of America;* **81**: No. 13, vp(Jul 1984). Contract AC02-76ER01338.

A loss of electron transport capacity in chloroplast membranes was induced by high-light intensities (photoinhibition). The primary site of inhibition was at the reducing side of photosystem II (PSII) with little damage to the oxidizing side or to the reaction center core of PSII. Addition of herbicides (atrazine or diuron) partially protected the membrane from photoinhibition; these compounds displace the bound plastoquinone (designated as Q/sub B/), which functions as the secondary electron acceptor on the reducing side of PSII. Loss of function of the 32-kilodalton Q/sub B/ apoprotein was demonstrated by a loss of binding sites for [^{14}C]atraazine. We suggest that quinone anions, which may interact with molecular oxygen to produce an oxygen radical, selectively damage the apoprotein of the secondary acceptor of PSII, thus rendering it inactive and thereby blocking photosynthetic electron flow under conditions of high photon flux densities. 21 references, 4 figures, 2 tables.

23159 **Collagenase is a major gene product of induced rabbit synovial fibroblasts.** Aggeler, J.; Frisch, S.M.; Werb, Z. (Univ. of California, San Francisco). *Journal of Cell Biology;* **98**: No. 5, 1656-1661(May 1984). Contract AC03-76SF01012.

The effects of the tumor-promoting phorbol diester, 12-0-tetradecanoylphorbol-13-acetate (TPA), on rabbit synovial fibroblasts was investigated. This agent induced a major switch in gene expression in these cells that was marked by the specific induction of the neutral proteinase, collagenase, and was always accompanied by alteration in cell morphology. Procollagenase synthesis and secretion was first observed 6-12 h after the addition of TPA. The rate of collagenase production depended on the TPA concentration (1-400 ng/ml) and time of exposure (1-72 h). Procollagenase was the most prominent protein visible by direct silver straining or by autoradiography after SDS PAGE of [^{35}S]methionine-labeled proteins. The two procollagenase bands of M/sub r/ 53,000 and 57,000, which migrated as a family of spots on two-dimensional gels and were immunoprecipitated by antibodies to purified rabbit collagenase, accounted for 23% of the newly synthesized, secreted protein in TPA-treated cells. Cell-free translation of mRNA from TPA-treated cells in rabbit reticulocyte lysate produced a single band of immunoprecipitable preprocollagenase as a major product (5% of

total) that migrated as a single spot on two-dimensional gels. Secreted procollagenase preprocollagenase, and active collagenase (purified to homogeneity; specific activity 1.2 X 10^4 U/mg protein) had related peptide maps. Two other major secreted proteins, a neutral metalloproteinase of M/sur r/ 51,000 and a polypeptide of M/sub r/ 47,000, were also induced by TPA. In contrast to the induction of these four polypeptides, TPA decreased synthesis and secretion of a number of proteins, including collagen and fibronectin. Collagenase is a convenient marker for major alterations in the pattern of protein synthesis and secretion of rabbit synovial fibroblasts treated with TPA. 50 references, 5 figures.

23160 **Mutagenicity of quinones: pathways of metabolic activation and detoxification.** Chesis, P.L.; Levin, D.E.; Smith, M.T.; Ernster, L.; Ames, B.N. (Univ. of California, Berkeley). *Proceedings of the National Academy of Sciences of the United States of America;* **81**: No. 6, 1696-1700(Mar 1984). Contract AT03-76EV70156.

The mutagenicity of various quinones, a class of compounds widely distributed in nature, is demonstrated in the Salmonella TA104 tester strain. The metabolic pathways by which four quinones, menadione, benzo[a]pyrene 3,6-quinone, 9,10-phenanthrenequinone, and danthron, caused mutagenicity in this test system were investigated in detail as were the detoxification pathways. The two-electron reduction of these quinones by NAD(P)H-quinone oxidoreductase (DT-diaphorase) was not mutagenic, whereas the one-electron reduction, catalyzed by NADPH-cytochrome P-450 reductase, was mutagenic, except for danthron, which was only slightly mutagenic. The mutagenicity of the quinones via this pathway was found to be attributable to the generation of oxygen radicals. The cytochrome P-450 monooxygenase also played a significant role in the detoxification and bioactivation of these quinones. For example, phenanthrenequinone was converted to a nonmutagenic metabolite in a cytochrome P-450-dependent reaction, whereas danthron was converted to a highly mutagenic metabolite. These studies show the complexity of metabolic pathways involved in the mutagenicity of quinones. 32 references, 3 figures, 2 tables.

23161 **Evaluation of models for predicting terrestrial food chain behavior of xenobiotics.** Garten, C.T. Jr.; Trabalka, J.R. (Oak Ridge National Lab., TN). *Environmental Science and Technology;* **17**: No. 10, 590-595(Oct 1983). Contract W-7405-ENG-26.

The authors evaluated the adequacy and capabilities of proposed univariate regression models for predicting the bioaccumulation of xenobiotic compounds in terrestrial vertebrates for physicochemical properties (structure-activity relationships) or from bioaccumulation by fish. Their findings raised doubts about the generic application of such statistical models, even for purposes for screening large numbers of compounds for potentially high bioaccumulation. They developed a screening level model based on lipophilic tendency of xenobiotic compounds which identified all compounds, but one, with a high bioaccumulation potential in fish, mammals, and birds, from large numbers of compounds. The one compound with a high bioaccumulation potential, which was not identified as such, represents an important class of toxic organic materials not accounted for in existing structure-activity relationships. Furthermore, their model incorrectly placed some compounds into the high bioaccumulation category when existing experimental data demonstrate low actual bioaccumulation. Problems such as those identified suggest that structure-activity relationships are not an adequate substitute for laboratory feeding trials in predicting the bioaccumulation potential of a xenobiotic compound. 15 references, 5 tables.

23162 **Toxic and biochemical effects of divalent metal ions in Drosophila: correlation to effects in mice and to chemical softness parameters.** Jacobson, K.B.; Turner, J.E.; Christie, N.T.; Owenby, R.K. (Oak Ridge National Lab., TN). *Science of the Total Environment;* **28**: 355-366(1983). Contract W-7405-ENG-26.

The mechanism of toxicity of 11 divalent cations was evaluated by determining the effects of dietary administration to Drosophila melanogaster and measurement of the frequency of lethality at 4 days, alterations in the developmental patterns of proteins, and changes in specific transfer RNAs. The relative effectiveness of divalent cations to kill Drosophila is significantly correlated to the relative values of the coordinate bond energy of the metal ions. The resistance of Drosophila to cadmium toxicity appears to be genetically determined since different inbred strains vary markedly. Also, the resistance is maximal in the young adult. Two different genetic strains seem to respond to different cations (Cd^{2+}, Hg^{2+}, Cu^{2+}, Co^{2+}, Ba^{2+}, and Sr^{2+}) in a similar manner. Basic mechanisms of toxicity may be studied in Drosophila as well as mice since the chemical properties of the metals reflect their toxic effects on the former as closely as the latter. 25 references, 5 figures, 1 table.

23163 **Cell proliferation in lung following acute fly ash exposure.** Hackett, N.A. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Toxicology;* **27**: 273-286(1983). Contract AC04-76EV01013.

Cell proliferation was examined in the lung parenchyma, the ciliated airway epithelium and the lymph nodes of Fischer-344 rats following 6-h exposure to fly ash obtained from the baghouse of an experimental fluidized bed combustor. About a 10-fold increase in labeling of the lung epithelial type II cells was observed following the 6-h fly ash exposure. There was also an increase in thymidine incorporation into DNA of alveolar macrophages. Labeling activity of macrophages within the lung was increased for up to 4 days following fly ash exposure; however, the size of the macrophage population was not altered. Following exposure, a higher labeling index was also observed in the epithelial cells of the airways. Labeling in the trachea reached a peak at 4 days after exposure while in the bronchi and in small airways (inside diameter of less than 0.35 mm) the highest level of labeling was observed at 1 day after exposure. Labeling in airway epithelial cells was increased 2-4 times above that of sham-exposed animals. Lung-associated lymph nodes accumulated particulate material and had variable amounts of [^{3}H]thymidine incorporation. These results demonstrate that acute inhalation exposure to fly ash initiated cell division or DNA synthesis in several cell populations of lung parenchyma and airways. 24 references, 5 figures.

23164 **Metabolic fate of benzo[a]pyrene in rats after inhalation.** Mitchell, C.E. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Toxicology;* **28**: 65-73(1983). Contract AC04-76EV01013.

Rats were exposed by inhalation to [^{3}H]benzo[a]pyrene aerosols for 30 min. The concentration of organic-soluble, water-soluble and covalently bound radioactivity was determined in rat lung, liver and kidney at 0.5, 6 and 24 h after exposure. The total amount of [^{3}H]BP decreased rapidly in the lung as a function of time after exposure. At 0.5 h after exposure, the organic-soluble radioactivity accounted for approx. 70% of the total radioactivity in the lung. The organic-soluble radioactivity in the liver and kidney was 24% and 21%, respectively, at 0.5 h after exposure. The organic-soluble radioactivity decreased in the lung to approx. 10% of the total radioactivity by 1 day after exposure. Thin-layer chromatography (TLC) of extracts indicated that the organic-soluble radioactivity in the lung at 0.5 h after exposure was comprised primarily of BP, 3-OH-BP, 9-OH-BP and quinones of BP. In contrast, the organic-soluble radioactivity in the liver and kidney at 0.5 h after exposure were primarily polar metabolites, dihydrodiols, and BP.

23165 **Acute toxicity of chlorine and bromine to fathead minnows and bluegills.** Wilde, E.W.; Soracco, R.J.; Mayack, L.A.; Shealy, R.L.; Broadwell, T.L. (E.I. du Pont de Nemours & Co., Aiken, SC). *Bulletin of Environmental Contamination and Toxicology;* **31**: 309-314(1983). Contract AC09-76SR00001.

The objective of this study was to compare the relative toxicity of chlorine and BCDMH to three types of fish in a freshwater system used for cooling a nuclear reactor. There are no previous studies comparing BCDMH toxicity with chlorine toxicity. Bromine chloride has been shown to be similar or slightly less toxic than chlorine. The results of this study indicate that chlorine and bromine produce similar residual halogen toxicity to fish. 19 references, 2 tables.

23166 **Beryllium and the growth of the bush beans.** Romney, E.M.; Childress, J.D.; Alexander, G.V. (Univ. of California, Los Angeles). *Science (Washington, D.C.);* 135: 786-787(9 Mar 1962).

Beryllium in nutrient solution inhibited the growth of bush beans. The initial symptom was retarded root development. Although severe stunting of plants occurred, the foliage retained normal color. Roots accumulated beryllium. Increased beryllium concentrations decreased calcium in roots, stems, leaves, and fruits, and also decreased magnesium in roots and stems. Phosphorus was slightly increased in stems, leaves, and fruit.

5604 Other Environmental Pollutant Effects

23167 **(AD-A—148866/7/XAB) Genetic effects of microwave exposure on mammalian cells in vitro. Volume 2. Appendix A. Cytogenetics and growth kinetics data, 850 MHz. Annual report, 1 July 1981-30 September 1982.** Meltz, M.L.; Harris, C.R.; Walker, K.A. (Texas Univ., San Antonio (USA). Health Science Center). Oct 1984. 44p. NTIS, PC A03/MF A01.

See also Volume 2, Appendix B, AD-A148 867.

This work is a continuation of studies designed to answer the question of whether radiofrequency radiation (RFR) at lower power levels (no greater than 10 mW/sq cm), where measurable heating in the exposure system cannot be detected, causes any transient or permanent alteration in series of subtle biochemical processes elicited in the DNA of mammalian cells. The specific process(es) being studied are: the effects of RFR on repair synthesis in normal human fibroblasts after ultraviolet light damage of the DNA; and the possible induction by RFR of sister chromatid exchanges or chromosome aberrations in Chinese Hamster Ovary cells. Additional information obtained in the latter studies includes any effects on cell viability (by cloning efficiency) or on cell growth (increase in cell number).

23168 **(AD-A—148867/5/XAB) Genetic effects of microwave exposure on mammalian cells in vitro. Volume 2. Appendix B. Cytogenetics and growth kinetics data, 1.2 GHz. Annual report, 1 July 1981-30 September 1982.** Meltz, M.L.; Harris, C.R.; Walker, K.A. (Texas Univ., San Antonio (USA). Health Science Center). Oct 1984. 70p. NTIS, PC A04/MF A01.

See also Volume 1, AD-A145 946.

This work is a continuation of studies designed to answer the question of whether radiofrequency radiation (RFR) at lower levels (no greater than 10 mW/sq cm), where measurable heating in the exposure system cannot be detected, causes any transient or permanent alteration in a series of subtle biochemical processes elicited in the DNA of mammalian cells. The specific process(es) being studied are: the effects of RFR on repair synthesis in normal human fibroblasts after ultraviolet light damage of the DNA; and the possible induction by RFR of sister chromatid exchanges or chromosome aberrations in Chinese Hamster Ovary cells. Additional information obtained in the latter studies includes any effects on cell viability (by cloning efficiency) or on cell growth (increase in cell number).

23169 **(EPRI-EA—3904) Evaluation of published studies analyzing the association of carcinogenesis with exposure to magnetic fields. Final report.** Roth, H.D. (Roth (H. Daniel) Associates, Inc., Rockville, MD (USA)). Mar 1985. 57p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920572.

This report contains assessments of two studies: (1) Wertheimer and Leeper, Electrical Wiring Configurations and Childhood Cancer, American Journal of Epidemiology, 1979; and (2) Fulton, Cobb, Preble, Leone, and Foreman, Electrical Wiring Configurations and Childhood Leukemia in Rhode Island, American Journal of Epidemiology, 1980. Wertheimer and Leeper suggested the existence of a wiring configuration effect; Fulton et al. did not. Wertheimer and Leeper also found evidence of elevated cancer deaths in presumably high-magnetic-field occupations. Data in both studies were analyzed using inappropriate statistical methods. To correct for this problem, the data in the Wertheimer and Leeper paper were reanalyzed under conservative assumptions. Some of their results were verified, but others were not. Reanalysis of the raw data in the Fulton study confirmed the authors' findings of no wiring configuration effect. Magnetic fields around subjects' homes were inadequately measured in both studies, hence the authors cannot infer a direct relationship between magnetic fields and cancer. Finally, Wertheimer and Leeper's occupational findings are highly questionable because: (1) they were based on data from only a single year; (2) the results did not show a consistent trend of elevated cancer trends for the occupations analyzed; (3) the authors did not establish whether the occupations analyzed were high-magnetic-field-exposure occupations; and (4) the authors failed to take into account determinants of cancer such as smoking and diet. 7 tables.

23170 **(EPRI-EA—3917) Evaluation of the effects of electric fields on implanted cardiac pacemakers. Final report.** Moss, A.J.; Carstensen, E. (Rochester Univ., NY (USA)). Feb 1985. 80p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920546.

The effects of extra high voltage (EHV) transmission line electric fields on pacemaker function were evaluated in 11 patients with seven different implanted pacemaker models from four manufacturers. Alteration in pacemaker function was demonstrated in five unipolar units (three different models) from two manufacturers during exposure to electric fields ranging from 2 to 9 kV/m, with total body currents from 47 to 175 μA. These electric fields and body currents are representative of values that can be encountered by individuals standing beneath EHV transmission lines. Transient alterations in pacemaker function observed in this study included inappropriate triggered activity, inhibition of impulse generation, reduction in rate, and reversion from demand to asynchronous mode. Electromagnetic interference from high voltage transmission lines can induce alterations in pacemaker function in certain designs of these devices. However, pacemaker manufacturers can incorporate appropriate circuits in the pacemaker design to eliminate this problem. 8 references.

23171 **(N—85-10458) Study of annoyance due to urban automobile traffic.** Aubree, D.; Auzou, S.; Rapin, J.M. (National Aeronautics and Space Administration, Washington, DC (USA)). Jul 1984. 73p. (NASA-TM—77514). NTIS, PC A04/MF A01.

Continuous traffic noise measurements were carried out over 48 hour periods in front of a hundred buildings in different types of streets in Paris and its suburbs. Physical interpretation of the results provides a noise prediction formula for a traditional type of street. The noise at each point was characterized by a limited number of parameters by means of factor analysis, and their effect on the degree of disturbance by 700 individuals questioned near the measurement stations was studied. It was found that many additional factors affect disturbance besides noise, and that the dispersion of replies for any given noise situation is very wide. A disturbance index is proposed which takes into account the daylight level L(50), the position of rooms in the dwelling exposed to noise, and the individual degrees of satisfaction with the area.

57 Health And Safety

REFER ALSO TO CITATION(S) 57000023149

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 58010022330, 22444, 22445

23172 **(DOE/ER/60075—T1) Permafrost research: an assessment of future needs.** (National Research Council, Washington, DC (USA). Committee on Permafrost). 1983. Contract FG01-82ER60075. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009402.

The current status of permafrost science and engineering was reviewed. Deficencies in current scientific knowledge and engineering experience were identified and research responsive to

these needs recommended. Although emphasis in this report is on arctica and subartic Alaska, many of the discussions and recommendations are applicable to Antarctica and non-permafrost areas where soils are subjected to annual freezing and thawing or are artificially frozen for construction purposes. 31 references. (ACR)

23173 **(EPRI-CS—3901-Vol.1) Groundwater manual for the electric utility industry. Volume 1. Geological formations and groundwater aquifers. Final report.** Barton, A.R. Jr.; Redwine, J.C. (Southern Co. Services, Inc., Birmingham, AL (USA)). Mar 1985. 338p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920571.

Major areas of concern to power companies include the leaching of both solid wastes and stored coal, land subsidence and sinkhole development, and seepage away from all types of impoundments. These groundwater considerations can produce substantial increases in the cost of generating electricity. The leaching of fly ash, bottom ash, coal piles, and other materials has recently developed into an area of major environmental concern. Federal, state, and local regulations require various degrees of leachate monitoring. Land subsidence and sinkhole development can adversely affect power-generating facilities and frequently result in substantial property losses. Seepage from impoundments of all sorts (for example, ash ponds or hydroelectric facilities) may result in substantial water losses, lost generation, reduced stability of structures, and in extreme cases, abandonment or failure of dikes and dams. The groundwater manual is organized into three volumes. Volume 1 explains hydrogeologic concepts basic to understanding the occurrence, availability, and importance of underground waters and aquifers. It also contains a glossary of terms on subsurface hydrology and discusses such topics as the hydrologic cycle, groundwater quality in the 12 major US groundwater regions, and groundwater regulation. (ACR)

23174 **(N—85-13304) Progress in lead/uranium zircon studies of lower paleozoic rocks of the southern Alexander terrane.** Saleeby, J.B.; Gehrels, G.E. (California Inst. of Tech., Pasadena (USA)). 1984. 4p. California Inst. of Tech., Pasadena.

In Geological Survey, the United States Geological Survey in Alaska, 110-113 p. (N—85-13283 04-42).

Geologic mapping and zircon lead/uranium geochronologic studies on southern Prince of Wales Island and southern Annette Island delineated a regional metaigneous complex that ties these two areas together during Ordovician and, possibly, earlier time. Metamorphic-mineral assemblages and fabrics indicate metamorphism to greenchist to amphibolite facies under both static and dynamic conditions.

23175 **(PB—85-139202/XAB) Development of a predictive model for porosity distribution in the Smackover formation of southwest Alabama. Research report (final), 1983-1984.** Benson, J. (Alabama Univ., University (USA). School of Mines and Energy Development). 15 Nov 1984. 66p. NTIS, PC A04/MF A01.

This study is an attempt to identify porosity types in the Smackover of southwest Alabama; to determine the distribution of the various porosity types; to define the mechanisms responsible for porosity evolution; and to develop a model useful in predicting porosity distribution in the Smackover in southwest Alabama. This porosity would be a tremendous aid both to the exploration geologist seeking new reserves in southwest Alabama.

5802 Geophysics

REFER ALSO TO CITATION(S) 58020022429, 23101

23176 **(N—85-11491) Vertical crustal movements in southern California, 1974 to 1978.** Burford, R.O.; Gilmore, T.D. (Geological Survey, Washington, DC (USA)). 1984. 26p. (LC—84-601023). NTIS, PC A03/MF A01.

An extensive resurvey of most of the first-order leveling network in southern California, known as the Southern California Releveling Program (SCRP), was carried out during the first 5 months of 1978. The primary scientific purpose of these measurements was to rapidly update the vertical control record throughout a recently uplifted region of southern California in order to more thoroughly document the vertical component of tectonic movement and to provide a reliable base for comparison with future levelings. Analyses of historic first-order leveling results have clearly demonstrated that a broad crustal upwarping, largely contained within a region consisting of the Transverse Ranges province and an area along the intervening section of the San Andreas fault system, had developed between about 1959 and 1974. Unfortunately, there is strong evidence that parts of the 1978 SCRP data are contaminated by the effects of intrasurvey tectonic deformation, limited surficial failures, and, less certainly, magnetically induced systematic error associated with the use of automatic levels. However, any distortions in leveling results caused by these or other factors are not so serious as to render the SCRP data useless.

23177 **(PB—85-149573/XAB) Innovations in earthquake and natural hazards research: determining soil liquefaction potential. Case study No. 5.** Moore, G.B.; Yin, R.K. (COSMOS Corp., Washington, DC (USA)). Nov 1984. 61p. NTIS, PC A04/MF A01.

See also PB84-133917.

This case study analyzes how an innovation in earthquake and natural hazards research was used for practical and policy purposes, why utilization occurred, and what potential policy implications can be drawn. The innovation was the dynamic analysis method, used to identify those soils that are likely to liquefy during earthquakes. The research was designed and undertaken by H. Bolton Seed at the University of California at Berkeley during the 1960s. The research was a major breakthrough in engineering research: liquefaction had never before been reproduced in a laboratory. The work yielded quantitative information about the conditions under which liquefaction occurs. These data were then used to develop procedures for predicting liquefaction; eventually the need to test soil samples in the laboratory was eliminated. The case study concluded that the interactions of Seed with a continuously active network of knowledge producers and users adequately explains the use of the dynamic analysis method. Future policies likely to favor utilization are those deriving from both a problem solving and a social interaction perspective.

23178 **(USGS-OFR—83-844) Workshop on continuing actions to reduce potential losses from future earthquakes in the Northeastern United States: proceedings of conference XXI.** Hays, W.W.; Gori, P.L. (eds.). (Geological Survey, Reston, VA (USA)). 1983. 174p. (CONF-8306263—). Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85900568.

From Workshop on continuing actions to reduce potential losses from future earthquakes in the Northeastern United States; Cambridge, MA, USA (13 Jun 1983).

This workshop was designed to define the earthquake threat in the eastern United States and to improve earthquake preparedness. Four major themes were addressed: (1) the nature of the earthquake threat in the northeast and what can be done to improve the state of preparedness; (2) increasing public awareness and concern for the earthquake hazard in the northeast; (3) improving the state of preparedness through scientific, engineering, and social science research; and (4) possible functions of one or more seismic safety organizations. Papers have been abstracted separately. (ACR)

23179 **(USGS-OFR—83-846) Workshop on continuing actions to reduce potential losses from future earthquakes in Arkansas and nearby states: proceedings of conference XXIII.** Hays, W.W.; Gori, P.L. (eds.). (Geological Survey, Reston, VA (USA)). 1983. 235p. (CONF-8309330—). Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85900612.

From Workshop on continuing actions to reduce potential losses from future earthquakes in Arkansas and nearby states; North Little Rock, AR, USA (20 Sep 1983).

The objective was to accelerate the ongoing work of the Arkansas Office of Emergency Services, providing a forum for discussion of their activities to prepare for and respond to the earthquake threat. Areas of discussion were: (1) the nature and extent of earth-

quake hazards in Arkansas; (2) responding to a hypothetical earthquake in Arkansas; and (3) formulating plans to deal with earthquake hazards in Arkansas. Papers have been individually abstracted for the data base. (ACR)

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 58030022393, 22416, 22443, 22445, 22453, 23172

23180 (EGG-M—04785) Laboratory studies of autogenous grinding for removal of calcite from the surface of basalt. Miller, R.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 41p. (CONF-851054—1; EGG/SE-M—84-006). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009109.

From Society of Mining Engineers fall meeting; Albuquerque, NM, USA (16 Oct 1985).

Basalt flows are exposed over about 75% of the Idaho National Engineering Laboratory (INEL) site. The exposed surfaces of joints in the basalt are frequently covered with calcite and the vesicles in the basalt are frequently filled with calcite. In the event of an accidental release of fission and activation products to the INEL environment, some of these radioisotopes, e.g., compounds of cesium, strontium, and cobalt, would come into contact with the basalt and could ion exchange with the calcite, especially that on the surface of the basalt. Experiments were designed to test the hypothesis that surficial calcite could be abraded from the basalt and concentrated into the fine size fractions of the product by autogenous grinding. Such material and its ion exchange analogs could then be more effectively removed and segregated as part of a decontamination effort. The results of this study indicate that the surficial calcite is abraded during the autogenous grinding and is concentrated into the minus 0.125-mm size fraction of the product. 7 references, 12 figures.

23181 (UCID—20370) Strength and static elastic moduli of Mesaverde rocks. Lin, W. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009668.

This report discusses the mechanical properties of Mesaverde rocks (shale and sandstone) from various depths in five wells in Colorado and Wyoming. The properties studied were tensile strength, compressive strength, hydrostatic compressibility, shear stress under strain-controlled compression, and static elastic moduli. With respect to these properties, the sandstones are virtually isotropic. The shales, on the other hand, are definitely anisotropic. The nature and degree of anisotropy of the shales vary with the depth of sample origin. The relative values of mechanical properties between the shale and the sandstone also vary with depth. 7 references, 17 figures, 8 tables.

23182 (UCRL—53597) Petite sismique measurements at the Spent Fuel Test - Climax. Zucca, J.J. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008931.

In May 1984, a petite sismique estimate of the deformation modulus (E) was carried out at the Spent Fuel Test - Climax (SFT-C) at the Nevada Test site. The first part of the experiment was to repeat an earlier suite of measurements that were taken before the spent fuel was emplaced to see if any changes had resulted from heating the rock mass. The results of this measurement indicate a decrease in the modulus. However, these results are suspect in view of the findings in the second part of the experiment, which was designed to minimize the effects due to spurious resonances in the source and geophone locations. These effects were thought to bias the earlier measurements. The measurements indicate that the rock acts as a low-pass filter to the propagating wavefield. Furthermore, it is noted that the blow from a hammer is not a purely impulsive source. Therefore, depending on the type of source used and the distance away from the source, a different peak frequency and, hence, E could be measured for the same rock mass. Unless these effects are somehow factored out of a petite sismique survey, the value of E obtained could be severely biased. 20 figures.

5805 Oceanography

REFER ALSO TO CITATION(S) 58050022463

64 PHYSICS. I.

6401 Astrophysics And Cosmology

23183 (AD-A—149183/6/XAB) Physical aspects of the prediction of solar flares. Sturrock, P.A. (Stanford Univ., CA (USA). Center for Space Science and Astrophysics). Nov 1984. 12p. NTIS, PC A02/MF A01.

The properties of a solar flare depend critically on the preflare magnetic-field configuration and the way that this configuration evolves during the flare process. The flare process often, if not always, involves the eruption of a filament or similar structure, possibly leading to complete ejection from the sun. This eruption will generate an extensive current sheet: reconnection of this sheet contributes to the gradual phase and perhaps also to the impulsive phase. It is proposed that reconnection of a current sheet (pre-existing, or generated by filament eruption) is required for a gamma-ray event or a particle event. A particle event requires also an escape mechanism that could be provided either by a pre-existing open current sheet or by the ejection of the magnetic-field configuration associated with a filament. Following these guidelines, it is possible to propose a classification of flares into seven categories and to propose whether or not each category will lead to the following phenomena: mass ejection, shock wave, gamma-ray emission, and particle event.

23184 (FNAL/C—84/135) Formation of galaxies. Szalay, A.S. (California Univ., Santa Barbara (USA). Inst. for Theoretical Physics; Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1984. Contract AC02-76CH03000. 8p. (CONF-8406234—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009537.

From International symposium on phase transitions in the very early universe; Bielefeld, F.R. Germany (1 Jun 1984).

The present theories of galaxy formation are reviewed. The relation between peculiar velocities and the correlation function of galaxies points to the possibility that galaxies do not form uniformly everywhere. Scale invariant properties of the cluster-cluster correlations are discussed. Comparing the correlation functions in a dimensionless way, galaxies appear to be stronger clustered, in contrast with the comparison of the dimensional amplitudes of the correlation functions. Theoretical implications of several observations as Lyman-α clouds, correlations of faint galaxies are discussed. None of the present theories of galaxy formation can account for all facts in a natural way. 29 references.

23185 (N—85-10887) Catalogue of the discrete sources in the declination range from -13 deg to -2 deg. Braude, S.Y.; Miroshnitchenko, A.P.; Sokolov, K.P.; Sharykin, N.K. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1984. 51p. (NASA-TM—77594). NTIS, PC A04/MF A01.

The results of the discrete source measurements with declinations -13 deg or delta or -2 deg and right ascensions 0 sub h + 24 sub h are given and were obtained as part of the systematic decametric survey of the celestial sphere with the rotatiotelecope UTR-2. Three hundred sixteen sources were found in the given declination range, four of which were observed for the first time. The source coordinates measured in the survey were compared with those from the 4th Cambridge survey at 178 MHz and the Parkes survey at 408 MHz.

23186 (N—85-10894) Giacobini-Zinner comet: polarimetric and physical observations. Martel, M.T.; Maines, P.; Grudzinska, S.; Stawikowski, A. (National Aeronautics and Space Administration, Washington, DC (USA)). Oct 1984. 19p. (NASA-TM—77771). NTIS, PC A02/MF A01.

The results of observations of the Giacobini-Zinner comet on 25 and 31 October 1959 are presented. The magnitude of the

comet was measured photoelectrically in two spectral regions. The radius is on the order of one kilometer. The photoelectric measurements of comets 1959b and 1957c were used to measure the abundances of the CN and C2 radicals and of solid particles in the heads.

23187 **(N—85-11923) Search for white dwarf companions of cool stars with peculiar element abundances.** Boehm-Vitense, E. (Washington Univ., Seattle (USA)). 1984. 9p. (NASA-CR—174030). NTIS, PC A02/MF A01.

A search for a white dwarf companions of cool stars with peculiar element abundances was undertaken. One additional star the xi Cet, was found with a white dwarf companion. It was found that HR 1016, 56Uma, 16 Ser, have high excitation emission lines which indicate a high temperature object in the system. It is suggested that since these indications for high temperature companions were seen for all nearby Ba stars, it is highly probable that all Ba stars have white dwarf companions, and that the peculiar element abundances seen in the Ba stars are due to mass transfer. Observations, arguments and conclusions are presented. White dwarf companions were not found. Together with the Li and Be abundances and the chromospheric emission line spectra in these stars were studied. No white dwarf companions were seen for subgiant CH stars.

23188 **(N—85-11932) Ultraviolet observations of Uranus and Neptune below 3,000 Angstrom.** Caldwell, J.; Wagener, R. (State Univ. of New York, Stony Brook (USA)). Oct 1984. 21p. NTIS, PC A99/MF A01.

In JPL Uranus and Neptune, 157-177p (N—85-11927 02-91).

From 2000 to 3000 A, both Uranus and Neptune have albedos that are about two times higher than Jupiter or Saturn's, implying that the outer giants have stratospheres that are relatively free of aerosol absorption. Uncertainties in the absolute calibration procedure allow discrepancies of order 15% between conservative models and the observations. A small amount of aerosol absorption is therefore possible. Below 2000 A the derived albedo is highly dependent on the solar spectrum source used in the data reduction. The most recent result for Uranus, first reported here, is consistent with a secular change in C2H2 mixing ratio from approximately three times ten to the minus eight in 1980 to less than or equal to ten to the minus ninth in 1983. These values are approximately 2 orders of magnitude less than the mixing ratios of this gas on Saturn, and comparable to the amount on Jupiter.

23189 **Majorons: A simultaneous solution to the large and small scale dark matter problems.** Gelmini, G. (European Organization for Nuclear Research, Geneva (Switzerland)); Schramm, D.N. (Chicago Univ., IL (USA); Fermi National Accelerator Lab., Batavia, IL (USA)); Valle, J.W.F. (Science and Engineering Research Council, Chilton (UK). Theory Div.). *Physics Letters, [Section] B;* **146**: No. 5, 311-317(18 Oct 1984).

It is shown that the existence of majorons, which enable a heavy neutrino, 500 eV < or approx. msub(νH) < or approx. 25 keV to decay into a light neutrino msub(νq)< or approx. 8 eV and a majoron, with lifetime 10^4 yr < or approx. tausub(νH) < or approx. 10^8 yr can solve both the large and small scale dark matter problems. For a primordial 'Zeldovich' spectrum of fluctuations the limits are msub(νH) < or approx. 550 eV and tausub(νH) > 10^7 to 10^8 Yr (the ranges msub(νH) < or approx. 500 eV and tausub(νH) > or approx. 10^8 yr are allowed by the model but galaxy formation becomes problematic). The large scale dark matter problem is how to achieve the critical density as implied by inflation, the small scale problems deal with the halos of galaxies and galaxy formation and perturbation growth. The heavy neutrino could provide the solution to the small scale problem by initiating perturbation growth before decoupling. The decay products will be fast and thus not bound to the initial clumps, thus solving the large scale problem. The low mass relic neutrinos that were not decay products would remain bound in the gravitational potentials which grew from the initial perturbations. The resulting universe would be radiation dominated, which is consistent with present observations if H_0 < or approx. 40 km/s/Mpc. An alternative solution can occur when msub(νL) approx.= 10 eV: the universe can again become matter dominated in the present epoch. This solution still allows H_0 approx.= 50 km/s/Mpc. The majoron model parameters which best fit the dark matter considerations are presented.

23190 **Cygnus X-1 revisited.** Liang, E.P.; Nolan, P.L. (California Univ., Stanford). *Space Science Reviews;* **38**: 353-384(Jul 1984). Contract W-7405-ENG-48.

The X- and gamma-ray observations of Cygnus X-1 and their theoretical interpretations are reviewed, with emphasis on new developments since the mid-1970s. The overall data base at present is most consistent with the inverse Compton model by hot thermal electrons of T(e) of about 10 billion K, for the hard X-ray luminosity (10-200 keV). However, the origin of the soft X-rays (not greater than 10 keV) in high states and gamma rays (greater than 200 keV) remain unsettled. 194 references.

23191 **Massive magnetic monopoles in cosmology and astrophysics.** Kolb, E.W. (Los Alamos National Lab., NM). *Annals of the New York Academy of Sciences;* **422**: 33-44(1984). (CONF-821227—).

From 11. Texas symposium on relativistic astrophysics; Austin, TX, USA (12 Dec 1982).

The astrophysical and cosmological consequences of magnetic monopoles are discussed. The production of monopoles during phase transition in the early universe is addressed, and proposals which have been made to alleviate the monopole problem are summarized. Astrophysical limits on galactic magnetic monopoles are discussed along with experimental efforts to detect monopoles. Finally, monopole-induced proton decay is addressed. 48 references.

23192 **Big bang nucleosynthesis: fateway to the very early universe.** Turner, M.S. (Chicago Univ., IL). *Annals of the New York Academy of Sciences;* **422**: 106-117(1984). (CONF-821227—). Contract AC02-80ER10773.

From 11. Texas symposium on relativistic astrophysics; Austin, TX, USA (12 Dec 1982).

The status of the concordance of the standard model of primordial nucleosynthesis with current observational data is reviewed. It is concluded that at present the standard model is consistent with all the observational data provided that the baryon-to-photon ratio is (3-7) x 10 to the 10th and the number of light neutrino species is four or less. Should the primordial mass fraction of He-4 be found to be 0.22 or less, the standard model is in serious difficulty. 60 references.

23193 **Millisecond pulsar.** Cheng, A.F. (Rutgers Univ., Piscataway, NJ). *Annals of the New York Academy of Sciences;* **422**: 182-185(1984). (CONF-821227—).

From 11. Texas symposium on relativistic astrophysics; Austin, TX, USA (12 Dec 1982).

The formation of millisecond pulsars is addressed. Evolutionary scenarios involving the spinning up of pulsars by accretion disks are discussed, and the implications of the P(dot)-P diagram for a large sample of radio pulsars are examined. 13 references.

23194 **Interaction of supernova ejecta with interstellar and circumstellar matter.** Liang, E.P.; Chevalier, R.A. (California Univ., Livermore). *Annals of the New York Academy of Sciences;* **422**: 233-236(1984). (CONF-821227—). Contract W-7405-ENG-48.

From 11. Texas symposium on relativistic astrophysics; Austin, TX, USA (12 Dec 1982).

The series of one-dimensional numerical simulations of supernova ejecta interactions with both interstellar and circumstellar matter whose results are presented was prompted by Chevalier's (1982) indication that the late time behavior of such interactions can be modeled by certain exact analytic self-similar solutions corresponding to ideal gas spheres whose profiles expand into a rarefied ambient medium. The density profile of the interaction region between the forward and reverse shocks seems to be Rayleigh-Taylor unstable. An attempt is made to check the validity and limitations of self-similar solutions and to note the change in the shock structure when electron and ion thermal conductivities are included and the ion temperature is greater than the electron temperature.

6402 Atmospheric Physics

23195 (AD-A—147927/8/XAB) Earth's radiation belts. Technical report. Schulz, M. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 28 Sep 1984. 46p. (TR—0084(4940-06)-4). NTIS, PC A03/MF A01.

This report reviews the status of radiation-belt science at the close of the data-acquisition phase (1976-79) of the International Magnetospheric Study (IMS). The purpose is to place recent discoveries in context with respect to long-standing problems, and to indicate possible directions for future research in radiation-belt physics. The review includes a synopsis of results achieved on topics related to the source, energization, transport, and loss processes that affect geomagnetically trapped radiation, as well as results concerning certain subtle consequences of adiabatic charged-particle motion. Major areas of interest include the effects of charge exchange and radial transport on the ion composition of the ring current and radiation belts, the measurement of ion distributions in all three dimensions of velocity space, and the evolution of radiation-belt particle intensities as a consequence of temporal variations of transport coefficients and boundary conditions over the solar cycle and over the course of a magnetic storm. Moreover, the realization is developing that the major uncertainties in radiation-belt physics lie beyond the radiation belts themselves.

23196 (AD-A—148772/7/XAB) Status report on environment, propagation and system modeling for an elf/vlf/lf(extremely low frequency/very low frequency/low frequency) ionospheric dependent propagation code. Technical report. Rutherford, R.R.; Knapp, W.S. (Kaman Tempo, Santa Barbara, CA (USA)). 28 Jun 1983. 54p. NTIS, PC A04/MF A01.

This report describes the continuing work on WEDCOM during the 1982 contractual period. Environmental models were updated and efficient propagation computational procedures were implemented to reduce execution time. Procedures were developed to provide the WEDCOM user with an automated method of selecting calculation times and ionization profile locations consistent with nuclear environmental sensitivities. VLF/LF signal processing models were adapted for use in WEDCOM and procedures for including atmospheric noise were developed.

23197 Magnetotail energy storage and release during the CDAW 6 substorm analysis intervals. Baker, D.N.; Fritz, T.A.; McPherron, R.L.; Fairfield, D.H.; Kamide, Y.; Baumjohann, W. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico). *Journal of Geophysical Research;* **90**: No. A2, 1205-1216(1 Feb 1985).

A primary goal of the Coordinated Data Analysis Workshop (CADW) 6 has been to study the flow of energy from the solar wind through the magnetosphere and in so doing to examine the role of magnetotail storage and rapid dissipation of this energy during magnetospheric substorms. The chosen intervals for CDAW 6 analysis (March 22 and March 31 to April, 1 1979) are well suited for such studies since spacecraft were situated upstream (IMP 8 and ISSE 3) to measure magnetospheric energy input from the solar wind and spacecraft were also located in the magnetotail (ISEE 1, 2) and the midnight sector at geostationary orbit (76-059, 77-007, GEOS 2, GOES 3) during several of the substorm periods. Using solar wind, magnetotail, and geostationary particle and field data, as well as ground-based information, we present the evidence for enhanced solar wind—magnetosphere coupling and concomitant increases of stored magnetotail energy. Clear examples of energy storage are found prior to the 1055 and 1435 UT substorms of March 22, as well as the 0250 UT and 2250 UT substorms on April and March 31, respectively. In these cases we estimate the total energy increase in the tail prior to the substorm onsets, and we estimate the dissipation rate of this energy during the substorms themselves. Typical total energy increases in the tail ($>$ or $\approx 5 \times 10^{22}$ ergs) appear to be more than adequate to supply the substorm energy dissipation inferred from ground-based and spacecraft observations.

23198 Magnetotail plasma observations during the 1054 UT substorm on March 22, 1979 (CDAW 6). Paschmann, G.; Sckopke, N.; Hones E.W. Jr. (Institut fuer extraterrestrische Physik, Max-Planck-Institut fuer Physik und Astrophysik, Garching bei Muenchen, Federal Republic of Germany). *Journal of Geophysical Research;* **90**: No. A2, 1217-1230(1 Feb 1985).

The paper reports ISEE 1 and 2 plasma observations in the plasma sheet near 15 R/sub E/ radial distance for the 1054 substorm on March 22, 1979. Noteworthy features are plasma sheet thinning and the brief appearance of rapid tailward flows after substorm onset, strong earthward flows (superimposed on dawnward convection) at the beginning of plasma sheet expansion and a quieting of all plasma properties at substorm recovery. Much of the time, however, plasma flows are small and switch directions. In particular, no strong flows are observed during neutral sheet crossings. Two-dimensional velocity distribution functions show a complex behavior, with several plasma components often coexisting and at times streaming in opposite directions. The interpretation of the observations in terms of the formation of a neutral line earthward of and close to ISEE at substorm onset is tempting, but three-dimensional spatial effects as well as rapid temporal changes have to be invoked to obtain consistency.

23199 Substorm effects on the plasma sheet on composition on March 22, 1979 (CDAW 6). Lennartsson, W.; Sharp, R.D.; Zwickl, R.D. (Lockheed Palo Alto Research Laboratory, Palo Alto, California). *Journal of Geophysical Research;* **90**: No. A2, 1243-1252(1 Feb 1985).

Data from the Plasma Composition Experiment on ISSE 1, covering the energy range 0.1—16 keV/e, show that a dramatic change took place in the plasma sheet ion composition in conjunction with the magnetic substorm activity on March 22, 1979. Beginning about 1124 UT the ion population at the ISEE 1 location changed from what appeared to be predominantly ions from the solar wind to a mixture of comparable numbers of solar wind and terrestrial ions. ISEE 1 was inbound in the predawn sector during this time, and the plasma composition experiment provided data from R≅21 R/sub E/ and LT≅0130, down to R≅3 R/sub E/ and LT≅0530. Prior to the substorm activity about 90—95% of the ion density was due to H^+ and He^{++} ions, which appeared to be mostly of solar wind origin. The H^+ and He^{++} components, each approximated by a Maxwell-Boltzmann distribution, had a temperature ratio $T(He^{++})/T(H^+) \cong 4$ and a density ratio $n(He^{++})/n(H^+) \cong 1.5$—3%. Both values are consistent with measurements made concurrently in the solar wind by the plasma experiment on ISSE 3. The remaining 5—10% of the density was due mainly to O^+ and He^+ ions of ionospheric origin. All four ion populations had broad energy spectra with mean energies of several keV/e.

23200 Role of heavy ionospheric ions in the localization of substorm disturbances on March 22, 1979: CDAW 6. Baker, D.N.; Fritz, T.A.; Lennartsson, W.; Wilken, B.; Kroehl, H.W.; Birn, J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico). *Journal of Geophysical Research;* **90**: No. A2, 1273-1282(1 Feb 1985).

Extensive ground-based arrays of magnetometers and numerous satellite platforms in the outer magnetosphere have established that two separate substorm expansion onsets occurred on March 22, 1979. The first of these occurred at 1055 UT and is demonstrated to be localized in the 0200—0300 LT sector. Concurrent plasma sheet ion composition measurements are used to show that the growth and expansion phase of this substorm occurred while the outer magnetosphere was composed dominantly of solar wind (H^+ and He^{++}) plasmas. The 1055 UT substorm greatly perturbed and altered the ion composition of the plasma in the outer magnetosphere such that the second substorm expansion onset (1436 UT) occurred while the outer magnetospheric plasmas were dominantly of ionospheric (O^+) origin. The 1436 UT substorm is shown to have a component of the westward electrojet localized further westward in local time relative to the first substorm. These results are a consistent, well-documented example of the possible important role of heavy ions in the localization and initiation of plasma sheet instabilities during substorms.

23201 Beam-driven ion cyclotron harmonic resonances in the terrestrial foreshock. Smith, C.W.; Goldstein, M.L.; Gary, S.P.; Russell, C.T. (Space Science Center, Department of Physics, University of New Hampshire, Durham). *Journal of Geophysical Research;* 90: No. A2, 1429-1434(1 Feb 1985).

We report an observation of low-frequency terrestrial upstream waves which exhibit enhancements in the magnetic field power and polarization spectra at harmonics of the proton cyclotron resonance. These magnetic fluctuations exist concurrent with a "diffuse" suprathermal proton population, but a field rotation immediately following the wave observation reveals a "reflected" suprathermal distribution. We also compute instability growth rates due to this highly anisotropic "reflected" component and find relative maxima at frequencies corresponding to the enhancements in the observed spectra. We thus infer that the multiple spectral peaks are due to resonant, electromagnetic ion beam instabilities and conclude that the observed ion beam is the source of the observed upstream waves. Spectral analysis of the polarization, magnetic helicity, and minimum variance directions supports this interpretation. We find observational and theoretical evidence for both right-hand polarized waves propagating parallel to the mean magnetic field and left-hand polarized waves propagating oblique to the mean field.

23202 Collisional tearing in a field-reversed sheet pinch assuming nonparallel propagation. Quest, K.B.; Coroniti, F.V. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* 90: No. A2, 1469-1472(1 Feb 1985).

We examine the linear stability properties of the collisional tearing mode in a reversed-field sheet pinch assuming that the wave vector is not parallel to B, where B is the equilibrium magnetic field. We show that pressure balance in the direction of the equilibrium current requires a nonzero perturbed current component δJ/ sub z/ that is driven toward tyhe center of the pinch. At the center of the pinch, δJ/sub z/ goes to zero, and momentum is balanced by coupling to the ion-acoustic mode. In order to achieve current closure, a large perturbed field-aligned current is generated that is strongly localized about the dissipative tearing layer. The relation of this work to the collisionless case is discussed.

23203 Azimuthal propagation and frequency characteristic of compressional Pc 5 waves observed at geostationary orbit. Takahashi, K.; Higbie, P.R.; Baker, D.N. (University of California, Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* 90: No. A2, 1473-1485(1 Feb 1985).

Energetic particle data from the 1977-007 and 1979-053 satellites and magnetic field data from the GOES 2 and 3 satellites have been used to study eight compressional Pc 5 wave events observed at geostationary orbit during 1979. All the events occurred on the dayside, and most of them were observed during the recovery phase of a geomagnetic storm. By using the data from two of the satellites which were close to each other, we measured the azimuthal phase velocity V/sub phi/ and azimuthal wave number m for selected intervals. For all these intervals the waves propagated westward in the spacecraft frame, and we obtained ' V/sub phi/ ' = 4—14 km/s and ' m ' = 40—120. In addition, harmonics of a local standing Alfven wave were often present simultaneously with a compressional Pc 5 wave. The frequency of the compressional wave was typically 25% of that of the second harmonic of the Alfven wave. These observed features are discussed in the light of existing theories of instabilities in the ring current plasma.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 64030023274, 23284

23204 (AD-A—149474/9/XAB) Effects of dense, hot plasmas on atomic systems. Technical report. Gupta, U.; Orens, J.H. (Berkeley Research Associates, Inc., CA (USA)). 1 Mar 1983. 45p. NTIS, PC A03/MF A01.

This report covers research into equation-of-state properties and plasma polarization effects produced by dense, hot plasmas on atomic systems. The work is part of a larger program to understand, simulate, and scale large x-ray sources under development by Defense Nuclear Agency.

23205 (DOE/ER/13262—T1) X-ray emission in heavy ion collisions. Progress report, January 1, 1984-February 1, 1985. Watson, R.L. (Texas A and M Univ., College Station (USA). Cyclotron Inst.). 1 Mar 1985. Contract FG05-84ER13262. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009321.

Topics covered include: projectile velocity dependence of the alignment of 2P states in foil-excited He-like sulfur projectiles; alignment of 2P states in He-like Neon recoil ions produced by 1.35 MeV/Amu Ar ion impact; and delayed emission of 2p-1s and 3p-1s x-rays from 40 MeV projectiles passing through a thin carbon foil.

23206 (DOE/ER/45072—T1) Spectroscopy of surface adsorbed molecules. Progress report, May 1, 1984-April 31, 1985. Coleman, R.V. (Virginia Univ., Charlottesville (USA). Dept. of Physics). 1985. Contract FG05-84ER45072. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009452.

Topics covered include the University of Virginia Tunneling Microscope, improvements in barrier height analysis for tunneling microscope and fabricated doped junctions, zero bias anomalies in doped tunnel junctions, tunnel barrier modifications with evaporated metal layers onto AlOx, and photoelectron spectroscopy studies of barriers and doped barriers. (GHT)

23207 (N—85-13559) Velocity-changing collisional effects in nonlinear atomic spectroscopy and photon echo decay in gases. Herman, R.M. (Pennsylvania State Univ., University Park (USA)). 1983. 15p. (NASA-CR—174159). NTIS, PC A02/MF A01.

A general theory of atomic dipole coherence under the influence of collisional phase changes, inelastic effects and optically active atom velocity changes, including those due to anisotropic interactions is presented. Velocity change effects are obtained in closed form. Line shapes appear as convolutions of standard pressure broadening contours with velocity-change contours. Width and shift parameters for the He-broadened Na D lines at 2 m bar pressure, 380 K are calculated, as are He-induced photon echo decay rates for these lines. Overall agreement with experiment is reasonably good.

23208 (ORNL—6089-Vol.4) Atomic data for controlled fusion research. Volume IV. Spectroscopic data for iron. Wiese, W.L. (ed.). (Oak Ridge National Lab., TN (USA); National Bureau of Standards, Washington, DC (USA)). Feb 1985. Contract AC05-84OR21400. 428p. NTIS, PC A19/MF A01. File Number DE85009658.

Comprehensive spectroscopic data tables are presented for all ions of Fe. Tables of ionization potentials, wave lengths of spectral lines, atomic energy levels, and transition probabilities are given which were excerpted from general critical compilations. All utilized compilations are less than five years old and include data on electric dipole as well as magnetic dipole transitions.

23209 (ORNL/TM—9478) Effect of external electric fields on the dielectronic recombination cross section of lithium and sodium like ions. Griffin, D.C.; Pindzola, M.S.; Bottcher, C. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010211.

The effect of external electric fields on the dielectronic recombination cross section associated with the $2s \rightarrow 2p$ excitation in the Li like ions B^{2+}, C^{3+}, O^{5+}, and Fe^{23+}, and the $3s \rightarrow 3p$ excitation in the Na like ions Mg^{+}, S^{5+}, Cl^{6+}, and Fe^{15+} has been studied in the configuration-average, distorted-wave approximation. By applying the linear-Stark approximation to the doubly-excited 2pnl and 3pnl Rydberg states in the presence of an external electric field, we study the systematics of field mixing effects on dielectronic recombination and determine the maximum field enhancement of the dielectronic recombination cross section. We find that the magnitude of the field enhancement decreases as we move up an isoelec-

tronic sequence and is of the order of a factor of two or three in highly-ionized systems. In addition, we show that dielectronic recombination transitions through doubly-excited states near threshold can produce large narrow peaks in the cross section at low energies, which are especially prominent in high stages of ionization, and are not affected by the electric field.

23210 **(SAND—84-2114C) Technique for measuring surface diffusion by laser-beam-localized surface photochemistry.** Zeiger, H.J.; Tsao, J.Y.; Ehrlich, D.J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1985. Contract AC04-76DP00789. 26p. (CONF-850273—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85007885.

From Topical meeting on microphysics of surfaces, beams and adsorbates; Santa Fe, NM, USA (4 Feb 1985).

A technique has been developed for determining the surface diffusivity of a weakly bound adsorbate by measuring the kinetics of a spatially localized, laser-beam-driven surface photoreaction. The diffusivity is extracted from the experimental data by means of a general theoretical analysis in which the diffusion equation is solved by a Green's function integral technique. The solution is numerically integrated in order to calculate the spatial and temporal evolution of the surface-number-density of parent and product molecules in a beam-localized adsorbate reaction. The new technique has been used to determine the surface diffusivity of tetraethyl lead molecules adsorbed on sapphire from data on the deposition of thin films by photolysis of these molecules. The technique may be more broadly applicable to the measurement of the surface diffusion of other weakly bound or fragile polyatomic molecules.

23211 **Multiphoton ionization of ammonia clusters and the dissociation dynamics of protonated cluster ions.** Echt, O.; Dao, P.D.; Morgan, S.; Castleman A.W. Jr. (Department of Chemistry, 152 Davey Laboratory, The Pennsylvania State University, University Park, Pennsylvania 16802). *Journal of Chemical Physics;* **82**: No. 9, 4076-4085(1 May 1985).

Ammonia clusters, produced via supersonic expansion, are subjected to multiphoton ionization using a tunable pulsed laser. The products of ionization and subsequent dissociation processes are investigated using a time-of-flight mass spectrometer equipped with a reflectron (reflecting electric field). Cluster ions containing more than 65 ammonia molecules were formed via internal ion molecule reactions taking place within the initially ionized aggregate. The proton transfer reaction which ensues leads to substantial excess internal energy and subsequent cluster decomposition. Dissociation due to both collisional and unimolecular processes was identified in the field-free region. Studies of the dynamics of dissociation were made for species up to the protonated 16-mer; the loss of up to at least five monomer units following cluster ion formation was observed. Results of an investigation of the influence of laser fluence and the energy of the ionizing photons are also presented.

23212 **Vibrational energy levels of formaldehyde.** Romanowski, H.; Bowman, J.M.; Harding, L.B. (Department of Chemistry, Illinois Institute of Technology, Chicago, Illinois 60616). *Journal of Chemical Physics;* **82**: No. 9, 4155-4165(1 May 1985). Contract W-31-109-ENG-38.

Vibrational energies for nonrotating H_2CO and D_2CO are calculated using unadjusted and adjusted ab initio quartic force fields in normal mass-weighted coordinates. Converged energies are obtained using uncoupled anharmonic oscillator and vibrational self-consistent field basis sets and are compared with experiment. Strong "Fermi-like" resonances are found involving the CH symmetric and antisymmetric stretches.

23213 **Theoretical investigation of Li and Be atom complexes with H_2O.** Curtiss, L.A.; Pople, J.A. (Chemical Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **82**: No. 9, 4230-4235(1 May 1985). Contract W-31-109-ENG-38.

The structures, energetics, and vibrational frequencies of the Li—OH_2 and Be—OH_2 complexes have been examined by ab initio molecular orbital methods including the effects of electron correlation by Moller—Plesset perturbation theory. Previous studies, at the Hartree—Fock level, indicated the existence of only a very weak van der Waals-type complex between Be and H_2O, while the Li—OH_2 complex was strongly bound (10—11 kcal/mol) at this level. In contrast, we find that, when correlation effects are included, the Be interaction with H_2O is quite similar to that of Li with H_2O. The Be—OH_2 complex is predicted to be nonplanar and significantly bound with a short Be—O distance of 1.736 A and a dissociation energy of 5.53 kcal/mol. The Li—OH_2 complex at the correlation energy level is nonplanar with a Li—O bond distance of 1.90 A and a dissociation energy of 13.77 kcal/mol. Calculated shifts in the vibrational frequencies of H_2O in Li—OH_2 at the correlated level are in good agreement with the experimental values, whereas Hartree—Fock level frequency shifts are in disagreement.

23214 **Infrared studies of autoionization of thin films of dinitrogen tetroxide.** Jones, L.H.; Swanson, B.I.; Agnew, S.F. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **82**: No. 9, 4389-4390(1 May 1985).

The autoionization of dinitrogen tetroxide to form nitrosonium nitrate in thin films at 150—200 K has been studied using infrared absorption spectroscopy. It is found that at these temperatures and low pressure the process is intramolecular, involving only one of two isomers of the nitrite form ($ONONO_2$). (AIP)

23215 **Test of the electronic structure of Fe(100) by absorbed current spectroscopy.** Kisker, E.; Kirby, R.E.; Garwin, E.L.; King, F.K.; Tamura, E.; Feder, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Journal of Applied Physics;* **57**: No. 8, 3021-3023(15 Apr 1985).

The absorbed electron current for a clean Fe(100) surface as a function of energy rises steplike at the vacuum-energy cutoff with an absorption close to 1. The smooth decrease of absorbed current at higher electron energy due to secondary electron emission is superimposed by a considerable amount of fine structure, the amplitude of which decreases with increasing energy. These features are found in good agreement with the results of a calculation of the elastic part of the electron reflection coefficient. Further, they are compared with the ferromagnetic electronic bulk band structure calculated above the vacuum energy. From the comparison with the experimental data, the energy dependence of the real and imaginary parts of the inner potential is determined.

23216 **Rotational analysis of the A ← X system of C_2H.** Curl, R.F.; Carrick, P.G.; Merer, A.J. (Chemistry Department and Rice Quantum Institute, Rice University, Houston, Texas 77251). *Journal of Chemical Physics;* **82**: No. 8, 3479-3486(15 Apr 1985). Contract AS05-79ER10477.

Precise frequencies for the observed lines of five bands of the A ^{2}Pi ← X $^2\Sigma$ system of C_2H are reported. These frequencies have been least-squares fitted with an effective rotational Hamiltonian and the resulting parameters are given.

23217 **Energy partitioning in He_2i/K collisions.** Burkhardt, C.E.; Earsom, D.L.; Daulton, T.L.; Garver, W.P.; Leventhal, J.J.; Gellene, G.I.; Porter, R.F. (Department of Physics, University of Missouri—St. Louis, St. Louis, Missouri 63121). *Journal of Chemical Physics;* **82**: No. 8, 3646-3649(15 Apr 1985).

Final state distributions and state-specific reaction cross sections for 1.5—6 keV He_2^+/K collisions have been determined from data acquired using both neutralized ion beam spectroscopy and direct observation of luminescence from decay of excited collision products. While several minor reaction channels can be identified, it is found that near-resonant processes yielding He_2(a $^3\Sigma$/sub u/$^+$) and He_2(A $^1\Sigma$/sub u/$^+$) are predominant. These major channels, both of which have cross sections in excess of 100 A^2, lead to substantial production of energetic metastable molecules and VUV continuum radiation extending from about 750 to 850 A.

23218 Atomic inner-shell excitation induced by coherent motion of outer-shell electrons. Boyer, K.; Rhodes, C.K. (Department of Physics, University of Illinois at Chicago, P. O.Xx 4348, Chicago, Illinois 60680). *Physical Review Letters;* **54**: No. 14, 1490-1493(8 Apr 1985). Contract AS08-81DP40142.

Outer-shell electrons coherently driven by intense radiation can transfer energy in a direct intra-atomic process to inner-shell excitations. Provided that the effective momentum transfer Δq is sufficiently low (Δq<owigh/a_0), the amplitudes governing the coupling of the outer electrons to the atomic core constructively sum. The effective cross section, which can be related to fast atom-atom collisions (>owig10 MeV/u), is evaluated in a limiting form closely resembling the Bethe result for inelastic electron scattering from atoms.

23219 Observation of electric quadrupole decay in Xe^{45+} and Xe^{44+}. Dietrich, D.D.; Chandler, G.A.; Fortner, R.J.; Hailey, C.J.; Stewart, R.E. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **54**: No. 10, 1008-1011(11 Mar 1985). Contract W-7405-ENG-48.

We have observed, for the first time in highly ionized atoms, electric quadrupole transitions between the 3p and 2p levels of fluorinelike and neonlike Xe^{45+} and Xe^{44+}. We have made precision measurements ($\lambda/\Delta\lambda = 2 \times 10^4$) of the relative wavelengths of the allowed electric dipole (E1) transitions and the forbidden electric quadrupole (E2) transitions connecting the n = 3 and the n = 2 levels. We have also derived from these measurements several Δn = 0 intervals between states of opposite parity.

23220 Electronic Spectrum and Energy Levels of the Deuterium Molecule. Freund, R.S.; Schiavone, J.A.; Crosswhite, H.M. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Physical and Chemical Reference Data;* **14**: No. 1, 235-383(Jan 1985).

Beginning in the 1930s, G.H. Dieke and his students carried out an extensive program of measuring the optical spectrum of molecular hydrogen and its isotopes. Parts of the work were published but the project was interrupted by Dieke's death in 1965, with much of the latest and most accurate work unpublished. This paper gives the 27 488 lines of molecular deuterium, measured by Dieke, arranges the 8243 assigned lines into band systems, and derives rotational—vibrational energy levels for over 50 electronic states. It also derives energy levels from published vacuum ultraviolet spectra of D_2.

23221 Volume production of negative ions in the reflex type ion source. Jimbo, K. Berkeley, CA; Univ. of California (1982). 192p. University Microfilms Order No. 83-12,860.Contract AC03-76SF00098.

Thesis (Ph. D.).

The production of negative hydrogen ions is investigated in the reflex-type negative ion source. The extracted negative hydrogen currents of 9.7 mA (100 mA/cm²) for H^- and of 4.1 mA (42 mA/cm²) for D^- are obtained continuously. The impurity is less then 1%. An isotope effect of negative ion production is observed. When anomalous diffusion in the positive column was found by Lehnert and Hoh (1960), it was pointed out that the large particle loss produced by anomalous diffusion is compensated by the large particle production inside the plasma, i.e., the plasma tries to maintain itself. The self-sustaining property of the plasma is applied to the reflex-type negative ion source. Anomalous diffusion was artificially encouraged by changing the radial electric field inside the reflex discharge. The apparent encouragement of negative ion diffusion by the increase of density fluctuation amplitude is observed. Twice as much negative ion current was obtained with the artificial encouragement as without. It is found from the quasilinear theory that the inwardly directed radial electric field destabilizes the plasma in the reflex-type ion source. The nonlinear theory based on Yoshikawa method (1962) is extended, and the anomalous diffusion coefficient in a weakly ionized plasma is obtained. The electrostatic sheath trap, which increases the confinement of negative ions in the reflex-type ion source, is also discussed.

23222 Visible and near IR Si-H vibrational overtones in SiH_4. Bernheim, R.A.; Lampe, F.W.; O'Keefe, J.F.; Qualey, J.R. III. (Pennsylvania State Univ., University Park). *Journal of Chemical Physics;* 1-3([1985]).

Absorption spectra in the 12,000 to 18,000 cm^{-1} range have been recorded for gaseous SiH_4 using intracavity photoacoustic detection with cw dye lasers. The observed transitions correspond to the Δ nu = 6-9 overtones of the Si-H local mode stretch and show considerable rotational structure.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 64042023052

23223 (AD-A—149074/7/XAB) Fundamental studies on MPD (Magneto Plasma Dynamics) thrusters. Annual report. Lawless, J.L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering). 1983. 20p. NTIS, PC A02/MF A01.

The major goals of this work are to determine erosion rates and the limits of diffuse mode operation. Major accomplishments of the first year include: identification of a new mode of onset, identification of a nondimensional flow-scaling parameter, a proposal for an improved design, and prediction of an anode thermal instability.

23224 (K/CSD/TM—53) FLOWPLOT II: a fluid dynamics and heat transfer plotting package. Cobb, C.K.; Tunstall, J.N. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1985. Contract AC05-84OT21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009802.

The FLOWPLOT II plotting program may be used with numerical or analytical fluid dynamics codes to create velocity vector plots, contour plots of up to three fluid parameters (e.g. pressure, density, and temperature), and two-dimensional profile plots, three-dimensional curve plots, and/or three-dimensional surface plots for either the u or v velocity components. FLOWPLOT II reads a data set written by the user's fluid dynamics code. This data set must contain parametric data at every nodal point of a uniform or non-uniform rectangular grid. FLOWPLOT II uses the DISSPLA (Display Integrated Software System and Plotting Language) graphics package. The user has the option of generating plots on CALCOMP or Versatec plotters, creating a compressed plot data set which can be plotted on various plotting devices, or generating plots on microfiche. An object module of FLOWPLOT II is available for execution on the IBM 3033 system at ORNL and on the IBM 360/195 system at ORGDP. This version of FLOWPLOT II is also available on the PDP-10 system at ORNL and can be used by personal computers running under a graphics terminal emulator.

23225 (LA-UR—85-848) Pattern selection and instability in nonlinear wave equation: an aspect of soliton and chaos. Imada, M. (Los Alamos National Lab., NM (USA); California Univ., Santa Barbara (USA). Dept. of Physics). 1985. Contract W-7405-ENG-36. 6p. (CONF-850165—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009578.

From Conference on solitons and coherent structures; Santa Barbara, CA, USA (11 Jan 1985).

Pattern selection problems are found in a variety of phenomena. Fluid dynamical systems and nonlinear diffusion phenomena give typical examples of pattern formation problems in dissipative systems. In some cases the dissipation reduces the effective dimension of the system, and this fact leads to several strikingly universal behaviors which were initially found in simple model systems with a few degrees of freedom. Nonlinear wave equations themselves, however, describes systems without dissipation in which the situation is more complicated. In spite of this complexity, many completely integrable systems are known in nonlinear wave equations, where neither ergodicity nor chaos is expected. With addition of small perturbation to completely integrable systems, one can see the growth of instability and the role of coherent structures in the pattern selection problem. Two aspects are briefly discussed in the following sections.

23226 (PB—85-150514/XAB) Persistent currents in superfluid ^{3}He. Pekola, J.P.; Simola, J.T. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). Aug 1984. 80p. (TKK-F-A—555). NTIS, PC E05/MF E01.

The authors report on measurements of persistent currents in superfluid (3)He-B and (3)He-A. An ac gyroscope, filled with 20 micrometer powder and mounted into a rotating nuclear refrigerator, was employed.

23227 (PB—85-150522/XAB) Symmetry and structure of quantized vortices in superfluid ^{3}He. Salomaa, M.M.; Volovik, G.E. (Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.). 1984. 150p. (TKK-F-A—539). NTIS, PC E07/MF E01.

Prepared in cooperation with Akademiya Nauk SSSR, Moscow.

The authors present a symmetry classification for the vortices in superfluid ^{3}He. They find that in superfluid ^{3}He-B there may exist five different singly quantized axially symmetric vortex lines, which are different from each other in their internal discrete symmetries. A phenomenological Ginzburg-Landau theory is constructed for all the possible phase transitions between the singly quantized axisymmetric vortices. Their detailed numerical calculations of the vortex core structure in the Ginzburg-Landau regime show that the vortex with minimum free energy, one they have identified with the vortex actually observed near T(c) in the NMR experiments on rotating ^{3}He-B, possesses a novel new structure: the discrete broken symmetry in this vortex is space parity P; the vortex has a superfluid core with the A phase and a spontaneously ferromagnetic B phase, which is not known to occur in bulk ^{3}He.

23228 (SAND—84-8703) Dynamic stability of a spinning tube conveying a flowing fluid. Benedetti, G.A. (Sandia National Labs., Livermore, CA (USA)). Feb 1985. Contract AC04-76DR00789. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85007583.

When a fluid flows inside a tube, the deformations of the tube can interact with the fluid flowing within it and these dynamic interactions can result in significant lateral motions of the tube and the flowing fluid. The purpose of this report is to examine the dynamic stability of a spinning tube through which an incompressible fluid is flowing. The tube can be considered as either a hollow beam or as a hollow cable. The analytical results can be applied to spinning or stationary tubes through which fluids are transferred; e.g., liquid coolants, fuels and lubricants, slurry solutions, high explosives in past form, etc. The coupled partial differential equations are determined for the lateral motion of a spinning Bernoulli-Euler beam or a spinning cable carrying an incompressible flowing fluid. The beam, which spins about an axis parallel to its longitudinal axis and which can also be loaded by a constant axial force, is straight, uniform, simply supported, and rests on a massless, uniform elastic foundation. Damping for the beam and foundation is considered by using a combined uniform viscous damping coefficient. The fluid, in addition to being incompressible, is frictionless, has a constant density, and flows at a constant speed relative to the longitudinal beam axis. The Galerkin method is used to reduce the coupled partial differential equations for the lateral motion of the spinning beam to a coupled set of 2N, second order, ordinary differential equations for the generalized beam coordinates. By simplifying these equations and examining the roots of the characteristic equation, an analytical solution is obtained for the lateral dynamic instability of the beam or cable. The analytical solutions determine the critical fluid speed and the critical spin speeds, for a specified fluid speed, in terms of the physical parameters of the system.

23229 (UCID—20392) Comment on "Warm relativistic electron fluid" [Phys. Fluids 25, 846(1982)]. Newcomb, W.A. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA). Dept. of Applied Science). 28 Mar 1985. Contract W-7405-ENG-48. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010028.

An important limiting case of the theory set forth in this paper is that in which the unperturbed orbits are of vanishingly small gyroradius. Following Chew et al., we treat this case by formal expansion in powers of m/e.

23230 Some bifurcation diagrams for Taylor vortex flows. Meyer-Spasche, R.; Keller, H.B. (Max Planck Institut fuer Plasmaphysik, D8046 Garching, West Germany). *Physics of Fluids;* **28**: No. 5, 1248-1252(May 1985). Contract AT03-76ER72012.

The numerical continuation and bifurcation methods of Keller [H. B. Keller, in Applications of Bifurcation Theory (Academic, New York, 1977), pp. 359—384] are used to study the variation of some branches of axisymmetric Taylor vortex flow as the wavelength in the axial direction changes. Closed "loops" of solutions and secondary bifurcations are determined. Variations with respect to Reynolds number show the same phenomena. The results presented here show that Taylor vortices with periodic boundary conditions exist in a wider range of wavelengths, λ, than observed in the Burkhalter/Koschmieder experiments [Phys. Fluids 17, 1929 (1974)]. They also show that there is possibly a λ subinterval within the neutral curve of Couette flow such that there are no Taylor vortex flows with smallest period in this interval.

23231 Angular correlations in dense hot diatomic fluids. MacGowan, D.; Johnson, J.D.; Shaw, M.S. (Department of Mathematics, Rutgers University, New Brunswick, New Jersey 08903). *Journal of Chemical Physics;* **82**: No. 8, 3765-3772(15 Apr 1985).

Molecular dynamics (MD) simulation data for rigid diatomic models of N_2 and CO_2 under conditions of extremely high density and temperature are analyzed for static correlation functions. The results show some significant qualitative differences from those for diatomic fluids at normal densities and temperatures (i.e., near the triple point). For a single thermodynamic state of N_2, the radial distribution functions (RDFs) of the (spherical) RAM and median potentials are found, also by MD. Whereas the median gives good thermodynamic results and poor centers correlation functions, RAM produces just the opposite. Thus no explanation in terms of distribution functions is found for the success of the median for thermodynamics although an empirical correlation is found between the breakdown of median thermodynamics for CO_2 and a distinctive feature of the molecular correlation functions.

23232 Planar theory made variational. Jackson, A.D.; Lande, A.; Smith, R.A. (Department of Physics, State University of New York, Stony Brook, New York 11794). *Physical Review Letters;* **54**: No. 14, 1469-1471(8 Apr 1985). Contract AC02-76ER13001.

Within the framework of boson parquet-diagram summations in perturbation theory, we show analytically that several simple approximations lead inevitably to the radial distribution function g(r) which would be obtained with the Jastrow hypernetted-chain variational method. This is the first derivation of the Jastrow result from perturbation theory. Without mentioning pair correlation functions, we have a clear interpretation of g(r) and the structure function, S(k), in terms of diagram sums.

23233 Two dimensional systems in solid state and surface physics: strong electric and magnetic fields effects. O'Connell, R.F. (Louisiana State Univ., Baton Rouge). *Journal de Physique (Paris), Colloque;* **43**: No. 11, C2.81-C2.96(Nov 1982). Contract AS05-79ER10459.

Two-dimensional condensed matter systems provide a fertile ground for the study of strong magnetic and electric field effects. We review the present status of studies in three such systems - the electron space-charge layer at the semiconductor surface in a metal-oxide-semiconductor (MOS) system, in heterojunction superlattices, and at the surface of liquid helium. In addition, we present the results of new theoretical calculations on the latter system, which we obtained in collaboration with J.A.C. Gallas.

6450 High Energy Physics

23234 (DOE/ER—0223) Annual report to the Working Group on Technology, Growth, and Employment. (USDOE Office of Energy Research, Washington, DC). Apr 1985. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009993.

A meeting of the Working Group on High Energy Physics was convened in Brussels, Belgium, in July 1984, and impaneled new groups of technical experts to report on long-term planning, technical collaborations, and the identification of administrative obstacles experienced within the Summit countries that impede international collaboration. The charges to these three new groups are contained in this report under the section on the Brussels meeting. The reports prepared by the technical experts were then reviewed at the January 1985 meeting at Cadarache, France, and the results are contained in this report under the section on the Cadarache meeting. The Summit Working Group on High Energy Physics believes progress is being made toward cooperation among the Summit countries in the exploration of scientific and technological development upon which the Summit Heads of State and Government declared at Versailles revitalization and growth of the world economy will depend - to a large extent. At Cadarache, the Group found that, since its establishment, international collaboration has increased in the use of present accelerators and in the planning for future accelerators. The Group also found that there are specific areas of technology in which near-term research cooperation is possible. Finally, the Group identified administrative regulations that hamper effective international collaboration in science and technology and that could be revised or eliminated through coordinated, high level Summit action. The major accomplishment of the Working Group thus far has been the creation of a forum for discussions on collaboration in a major field of science by seven industrialized countries. The Group recommends the continuation of its review of long-term plans for major facilities on an intergovernmental basis.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 64510023243, 23247, 23247

23235 (DOE/ER/40039—11) Progress report on the Texas A & M monopole experiment. Shepko, M.J. (Texas A and M Univ., College Station (USA). Dept. of Physics). 1984. Contract AS05-81ER40039. 3p. (CONF-8405155—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008369.

From Inner space/outer space conference; Batavia, IL, USA (2 May 1984).

The Texas A & M University high energy physics research group has just completed construction of a large scintillation telescope at the United Salt Corporation mine in Hockley, Texas to search for superheavy magnetic monopoles. Measurements include both the time of flight and specific ionization of particles passing through the detector. A GUT monopole event would be characterized by a rather long transit time between layers of the telescope coupled to the observation of fluorescence (either prompt or delayed) in the scintillation counters. The Texas A & M monopole detector was designed to achieve a sensitivity of 10^{-15} $cm^{-2}sec^{-1}sr^{-1}$ for a monopole velocity in the range of $8 \times 10^{-4} < \beta < 10^{-1}$. 5 references.

23236 (LA-UR—85-837) /sub Λ/^{5}He: hadrons or quarks. Gibson, B.F. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 3p. (CONF-8503120—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009577.

From Hadronic probes and nuclear interactions conference; Tempe, AZ, USA (11 Mar 1985).

Nuclear physics has dealt with nuclei and their interactions at interparticle distances which correspond to conditions that might be described as two bags of quarks barely overlapping. Here, where the asymptotically free theories of QCD have yet to provide a calculable picture of observed phenomena, the nuclear physicist has found a modicum of success and simplification in terms of a picture based upon the physically observable baryons and mesons. However, our understanding is far from complete. Because of this and our desire to learn where the transition to the quark-gluon matter picture occurs, we seek measurable effects due to the quark substructure. To that end, we must first define the limits of validity for describing nuclear phenomena in terms of the observed hadrons before evidence for quark-gluon degrees of freedom can be critically evaluated.

23237 (LBL—19195) Quark fragmentation in e^+e^- collisions. Oddone, P. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 47p. (CONF-8407112—6). NTIS, PC A03/MF A01; GPO Dep. File Number DE85008678.

From 12. SLAC summer institute on particle physics; Stanford, CA, USA (23 Jul 1984).

This brief review of new results in quark and gluon fragmentation observed in e^+e^- collisions concentrates mostly on PEP results and, within PEP, mostly on TPC results. The new PETRA results have been reported at this conference by M. Davier. It is restricted to results on light quark fragmentation since the results on heavy quark fragmentation have been reported by J. Chapman.

23238 (LBL—19287) Muoproduction of J/psi(3100). Markiewicz, T.W. (Lawrence Berkeley Lab., CA (USA)). Oct 1981. Contract AC03-76SF00098. 174p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85009897.

Interactions of 209-GeV muons within an instrumented magnetized-steel calorimeter have produced 4374 +- 87 $\mu^+\mu^-$ pairs from J/psi decay, corresponding to the cross section $\sigma(\mu N \rightarrow \mu$ psi X) = 0.64 +- 0.10 nb. These interactions are classified as either elastic (σ = 0.36 +- 0.07 nb) or inelastic (σ = 0.28 +- 0.06 nb) based primarily on the calorimetric determination of E/sub X/. The cross section for elastic psi production by virtual photons, σ/sub eff/(γ/sub V/N), rises with energy nu as log nu. Its dependence on Q^2 fits the vector-meson dominance form $P(\Lambda) = (1 + Q^2/\Lambda^2)^{-2}$, with Λ = (2.0 - 2.4) +- 0.15 GeV, where the spread in values arises from considering the possibility of a Q^2 dependence in the decay angular distribution W (θ,phi) and in the nuclear shadowing factor. We find that W(θ,phi) is consistent with the form expected if the reaction γ/sub V/N → psiN conserves helicity in the s channel through natural-parity exchange in the t channel. After correction for nuclear effects, d σ/sub eff//dt is described by the sum of two exponential terms in t, with average t slope b = 2.56 (+0.35 or - 0.32). The photon-gluon fusion ($\gamma g \rightarrow$ psi) perturbative quantum chromodynamic model for psi production provides an excellent description of the nu dependence of σ/sub eff/, but cannot simultaneously explain the observed cross section and value of Λ. The differential cross section $d^2\sigma$/sub eff//dzdp/sub perpindicular/^{2} for inelastically produced psi's rises approximately linearly with elasticity z identical with E/sub psi//nu. The p/sub perpendicular/^{2} dependence is flatter than that of d σ/dt for elastic events, with average p/sub perpendicular/^{2} slope b = 1.46 +- 0.10. The Q^2 dependence of σ/sub eff/ is that of P(Λ) with Λ = 3.0 +- 0.2 GeV, and the nu dependence is similar to that observed for elastic production. 101 references, 33 figures, 20 tables.

23239 (SLAC-PUB—3569) Measurements of heavy quark and lepton lifetimes. Jaros, J.A. (Stanford Linear Accelerator Center, CA (USA)). Feb 1985. Contract AC03-76SF00515. 14p. (CONF-8407112—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008321.

From 12. SLAC summer institute on particle physics; Stanford, CA, USA (23 Jul 1984).

The PEP/PETRA energy range has proved to be well-suited for the study of the lifetimes of hadrons containing the b and c quarks and the tau lepton for several reasons. First, these states comprise a large fraction of the total interaction rate in e^+e^- annihilation and can be cleanly identified. Second, the storage rings have operated at high luminosity and so produced these exotic states copiously. And finally, thanks to the interplay of the Fermi coupling strength, the quark and lepton masses, and the beam energy, the expected decay lengths are in the 1/2 mm range and so are comparatively easy to measure. This pleasant coincidence of cleanly identified and abundant signal with potentially large effects has made possible the first measurements of two fundamental weak couplings, tau → nu/sub tau/W and b → cW. These measurements have provided a sharp test of the standard model and allowed, for the first time, the full determination of the magnitudes of the quark mixing matrix. This paper reviews the lifetime studies made at PEP during the past year. It begins with a brief review of the three detectors, DELCO, MAC and MARK II, which have reported lifetime measurements. Next it discusses two new measurements of the tau lifetime, and briefly reviews a measurement of the D^0 lifetime.

Finally, it turns to measurements of the B lifetime, which are discussed in some detail. 18 references, 14 figures, 1 table.

23240 (UCRL—92373) Experiment to measure the electron neutrino mass using a frozen tritium source. Fackler, O.; Mugge, M.; Sticker, H.; White, R.M.; Woerner, R. (Rockefeller Univ., New York (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 9p. (CONF-8410224—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009584.

From AIP conference on neutrino mass and gauge structure of weak interaction; Telemark, WI, USA (24 Oct 1984).

We are performing an experiment to determine the electron neutrino mass with the precision of a few eV by measuring the tritium beta decay energy distribution near the endpoint. Key features of the experiment are a 2 eV resolution electrostatic spectrometer and a high-activity frozen tritium source. It is important that the source have electronic wavefunctions which can be accurately calculated. These calculations can be precisely made for tritium and the HeT^+ daughter ion and allow determination of branching fractions to 0.1% and energy of the excited states to 0.1 eV. We discuss the excited final molecular state calculations and describe the experimental apparatus. 2 references, 6 figures.

23241 pp and pp-bar elastic scattering at $\sqrt{s}$ = 0.55 to 40 TeV. Bourrely, C.; Soffer, J.; Wu, T.T. (Centre de Physique Theorique, Centre National de la Recherche Scientifique, Marseille, France). *Physical Review Letters;* **54**: No. 8, 757-759(25 Feb 1985). Contract FG02-84ER40158.

The recent data at $\sqrt{s}$ = 0.546 TeV from the CERN pp-bar collider confirm once more the predictions of the impact picture, which is based on quantum field theory. These predictions on pp and pp-bar total and elastic differential cross sections are extended to higher energies up to $\sqrt{s}$ = 40 TeV. They are of direct interest for future experiments at CERN, Fermilab, and the superconducting super collider.

6452 Particle Interactions And Properties - Theoretical

23242 (DOE/ER/40141—1) Comprehensive study of psi meson production. Progress report. Jones, S.T.; Harms, B.C. (Alabama Univ., University (USA). Dept. of Physics and Astronomy). 22 Feb 1985. Contract FG05-84ER40141. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008094.

Our first paper under this grant is a calculation of prompt lepton production in upsilon and toponium decay. The results should prove useful in identifying signals for charm or bottom production. Our work has led to some improvement in our understanding of psi production in hadronic interactions, although further work is needed. Attempts to explain the difference between experimental and theoretical rates of psi hadroproduction led to a study of quark-gluon scattering, which proved to have a negative impact on the theoretical cross section once a leading mass singularity was absorbed into the gluon distribution function. Our study of psi production in B meson decays has led to an improvement in the leading-log calculation of this rate, which gives a much more precise prediction of the decay rate. We have also calculated all first-order QCD corrections to this weak process. We are now completing a companion calculation of n/sub c/ production, for which there is presently no data. Dr. Harms and Dr. Cox have collaborated on an attempt to determine the dominant contribution to the difference σ(pN → psi x) - σ(anti pN → psi x). The lowest order process contributing to this difference (q anti q → psi GG) has been shown previously to be small. They have calculated the next order process (q anti q → G*G* → psi G) and have apparently uncovered a new example of the violation of the Bloch-Nordsieck mechanism in QCD. Our work outside the realm of QCD has included a new fit to the total pp and anti pp cross sections. Dr. Cox has also been pursuing the question of representations of extended (especially N=8) supersymmetry.

23243 (SLAC-PUB—3431) Weak interactions of quarks and leptons: experimental status. Wojcicki, S. (Stanford Linear Accelerator Center, CA (USA)). Sep 1984. Contract AC03-76SF00515;AC03-81ER40050. 76p. (CONF-8407112—3). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85008171.

From 12. SLAC summer institute on particle physics; Stanford, CA, USA (23 Jul 1984).

The present experimental status of weak interactions is discussed with emphasis on the problems and questions and on the possible lines of future investigations. Major topics include; (1) the quark mixing matrix, (2) CP violation, (3) rare decays, (4) the lepton sector, and (5) right handed currents. 118 references. (WHK)

23244 Fractional charge and spectral asymmetry in one dimension: A closer look. Blankenbecler, R.; Boyanovsky, D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **31**: No. 8, 2089-2099(15 Apr 1985). Contract AC03-76SF00515.

The physics of charge fractionalization is studied using a simple and physical approach. The normal-ordered charge is related to the Atiyah-Patodi-Singer invariant, and the physical interpretation of the spectral asymmetry is clarified in the presence of a continuous spectrum. By introducing the quantity B(E) which is a ratio of Jost-type determinants we relate the asymmetry to the phase and zeros or poles of B(E). The fractional part of the charge is determined by the high-energy behavior of the phase and the integer part is related to the spectral flow. We give simple examples showing that only the fractional part of the charge is a topological invariant; the integer part is determined by local properties of the background fields.

23245 Limits on the neutron-antineutron oscillation time from the stability of nuclei. Dover, C.B.; Gal, A.; Richard, J.M. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 4, 1423-1429(Apr 1985).

We have reexamined the question of what limit may be placed on the free space neutron-antineutron oscillation time tau/sub nn/ from a measured limit T_0 on the annihilation lifetime T of a nucleus. Using several recent antinucleon-nucleus optical potentials consistent with both p-bar-atom and low energy scattering data, we obtain a limit tau/sub nn/>(1 +- 0.3) x 10^8 sec if $T_0 = 2.4 \times 10^{31}$ yr. We consider the effect on our results of nuclear medium corrections such as a renormalization of the effective operator for n→n-bar transitions or the presence of additional $\Delta B = 2$ decay modes which are absent in free space. It is argued that renormalization effects are not likely to exceed those characteristic of nuclear β decay, and that if additional modes are present, the limit on tau/sub nn/ becomes even better.

23246 Coulomb effects and charge symmetry breaking for the A = 4 hypernuclei. Bodmer, A.R.; Usmani, Q.N. (Argonne National Laboratory, Argonne, Illinois 60439 and Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60637). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 4, 1400-1411(Apr 1985).

The effect ΔB/sub c/ of the Coulomb interaction on the Λ separation energy B/sub Λ/ of /sub Λ/^{4}He was obtained by variational calculations made for /sub Λ/^{4}He and ^{3}He. These calculations were made for several values of q^2 in the range $0 < \text{or} = q^2 < \text{or} = 9$ where qe is the proton charge, i.e., the Coulomb repulsion was artificially boosted. For $q^2 <$ or ≈ 3, the dependence on q^2 is linear, and interpolation to $q^2 = 1$ gives the physical values with improved accuracy: -ΔB/sub c/ = 0.05 +- 0.02 and 0.025 +- 0.015 MeV for the ground and excited state, respectively. This procedure also gives more accurate values for the differences between the proton and neutron radii of ^{3}He. The corresponding differences of B/sub Λ/ between /sub Λ/^{4}He and /sub Λ/^{4}H, to be attributed to charge symmetry breaking effects, are then 0.40 +- 0.06 and 0.27 +- 0.06 MeV. From these values we obtain a phenomenological charge symmetry breaking potential which is effectively spin independent. An examination of meson-exchange charge symmetry breaking models shows that these are consistent with the phenome-

nological charge symmetry breaking potential for the triplet but not for the singlet case.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 64530023243

23247 **(BNL—36122) Polarized protons and parity violating asymmetries.** Trueman, T.L. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-8409162—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009827.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

The potential for utilizing parity violating effects, associated with polarized protons, to study the standard model, proton structure, and new physics at the SPS Collider is summarized. 24 references.

23248 **Twisted model for large N lattice gauge theory.** Gonzalez-Arroyo, A.; Okawa, M. (Brookhaven National Lab., Upton, NY). *Physics Letters [Section] B;* **120B**: No. 1-3, 174-178(6 Jan 1983).

A model is proposed for the large N SU(N) lattice gauge theory, obtained by introducing twisted boundary conditions on the Eguchi-Kawai model. The simplest version corresponds to changing the sign of the coupling β in the EK model. The Schwinger-Dyson equations of our model are equivalent to those of the Wilson theory. We argue that $(U(1))^4$ symmetry is not broken. Monte Carlo data indicate that our model reproduces the main features of Wilson theory.

6454 Field Theory

REFER ALSO TO CITATION(S) 64540023241

23249 **(LA-UR—85-1092) Gravitational properties of antimatter.** Goldman, T.; Nieto, M.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850152—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009601.

From 3. LEAR workshop; Tignes-Savoie, France (19 Jan 1985).

Quantum gravity is at the forefront of modern particle physics, yet there are no direct tests, for antimatter, of even the principle of equivalence. We note that modern descriptions of gravity, such as fibre bundles and higher dimensional spacetimes, allow violations of the commonly stated form of the principle of equivalence, and of CPT. We review both indirect arguments and experimental tests of the expected gravitational properties of CPT-conjugate states. We conclude that a direct experimental test of the gravitational properties of antimatter, at the 1% (or better) level, would be of great value. We identify some experimental reasons which make the antiproton a prime candidate for this test, and we strongly urge that such an experiment be done at LEAR. 21 references.

23250 **Space-time: Arena or illusion?.** Kaplunovsky, V.; Weinstein, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **31**: No. 8, 1879-1898(15 Apr 1985). Contract AC03-76SF00515.

This paper develops a framework which allows us to treat the topology and dimension of the space-time continuum as dynamically generated. We present examples of quantum systems which are defined without a notion of space, but which nevertheless undergo a transition to a space-time phase. The dimension of the space is an integer-valued order parameter which characterizes distinct phases of a single system. We also show the interactions between the low-energy particles of the system are gaugelike. Finally, we discuss the computability of Newton's constant in this class of theories.

23251 **Restoration of spontaneously broken continuous symmetries in de Sitter spacetime.** Ratra, B. (Stanford Linear Accelerator Center and Department of Physics, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **31**: No. 8, 1931-1955(15 Apr 1985). Contract AC03-76SF00515.

We formulate a functional approach to scalar quantum field theory in (n+1)-dimensional de Sitter spacetime and solve the functional Schroedinger equation for the conformally and minimally coupled scalar fields in both the k = 0 and k = 1 gauges. We show that there is a natural initial condition, the requirement that the field energy remain finite as the scale factor a becomes small, which specifies a unique, time-dependent, de Sitter vacuum state. This initial condition is closely related to Hawking's prescription of including in the functional integral only those field configurations which are regular on the Euclidean section. The Green's functions constructed using this initial condition are explicitly shown to be the analytic continuation of those derived using the Euclidean path-integral formalism and the regularity (boundary) condition. These Green's functions are used to study the Hawking effect and the restoration of continuous symmetries. In particular we study the restoration of a broken O(2) symmetry of a Phi^4 theory. We argue that spontaneously broken continuous symmetries are always dynamically restored in de Sitter spacetime.

23252 **Simulations and speculations on gauge theories with many fermions.** Kogut, J.B.; Polonyi, J.; Wyld, H.W.; Sinclair, D.K. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review Letters;* **54**: No. 14, 1475-1478(8 Apr 1985). Contract W-31-109-ENG-38.

Simulation data of SU(2) and SU(3) gauge theories with a variable number of flavors ranging from zero to eight are gathered together and new data for the eight-flavor case are presented. The finite-temperature chiral transition is studied on 4×8^3 lattices and the critical coupling is recorded as a function of the number of flavors N/sub f/. The data exhibit stronger fermion screening as N/sub f/ increases and the SU(3) data display a new first-order phase transition at N/sub f/ = 8.

23253 **Resonance structure in kink-antikink interactions in phi^4 theory.** Campbell, D.K.; Schonfeld, J.F.; Wingate, C.A. (Los Alamos National Lab., NM). *Physica D: Nonlinear Phenomena (Amsterdam);* **90**: 1-32(1983).

New numerical and theoretical results are presented concerning kink-antikink collisions in the classical (nonintegrable) phi^4 field model in one-dimensional space. Earlier numerical studies of such collisions revealed that, over a small range of initial velocities, intervals of initial relative velocity for which the kink and antikink capture one another alternate with regions for which the interaction concludes with escape to infinite separation. The results of a new high-precision computer simulation that significantly extends and refines these observations of escape windows are described. A simple theoretical mechanism that appears to account for this structure in a natural way is discussed. The picture attributes the alternation phenomenon to a nonlinear resonance between the orbital frequency of the bound kink-antikink pair and the frequency of characteristic small oscillations of the field localized at the moving kink and antikink centers. The numerical simulation also reveals long-lived small-scale oscillatory behavior in the time dependence of kink and antikink velocity following those collisions that do not lead to capture. This fine structure is accounted for in terms of the interaction between kink (and antikink) motion and small amplitude radiation generated during and after the collision. Possible implications of the results for physical systems are discussed. 24 references, 15 figures, 3 tables.

23254 **Kink-antikink interactions in a modified sine-Gordon model.** Peyrard, M.; Campbell, D.K. (Los Alamos National Lab., NM). *Physica D: Nonlinear Phenomena (Amsterdam);* **9**: 33-51(1983).

The interactions of a kink (K) and an antikink (anti K) are studied numerically in a parametrically modified sine-Gordon model with potential $V(phi) = (1 - r)^3(1 - \cos phi)/(1 + r^2 + 2r \cos phi)$. As the parameter r is varied from the pure sine-Gordon

case (r = 0) to values for which the model is not completely integrable (r not equal 0), it is found that a rich structure arises in the K anti K collisions. For some regions of r(-0.20 ≦ r < 0) this structure is very similar to that observed in K anti K interactions in the phi^4 model, and it is shown that the theory recently suggested for these collisions also applies quantitatively to the modified sine-Gordon model. In other regions of r new scattering phenomena are observed, which are presented in detail numerically and are discussed in a qualitative manner analytically. 20 references, 15 figures, 5 tables.

6455 Scattering Theory

23255 **Formal scattering theory by an algebraic approach.** Alhassid, Y.; Levine, R.D. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **54**: No. 8, 739-741(25 Feb 1985). Contract AC02-76ER03074.

Formal scattering theory is recast in a Lie-algebraic form. The central result is an algebraic Lippmann-Schwinger equation for the wave operator from which an algebraic form of the Born series (containing only linked terms) is obtained. When a finite Lie algebra is sufficient, The Moller wave operator, on the energy shell, can be solved for explicitly as an element of the corresponding group. The method is illustrated for the separable potential whose relevant algebra is found to be U(1,1).

65 PHYSICS. II.

6513 Nuclear Properties And Reactions, A=6-19

23256 **Time-dependent Hartree-Fock studies of the sensitivity of dynamical fusion thresholds to the effective two-body interaction.** Maruhn, J.A.; Davies, K.T.R.; Strayer, M.R. (Institut fuer Theoretische Physik der Universitaet Frankfurt, Frankfurt, Federal Republic of Germany and Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 4, 1289-1296(Apr 1985).

Results are presented for time-dependent Hartree-Fock calculations of mostly head-on collisions of $^{86}Kr+^{139}La$ and $^{16}O+^{16}O$. These studies demonstrate the sensitivity of the time-dependent Hartree-Fock dynamical fusion thresholds to the effective two-body interaction used in the calculations. The main thrust of this paper is to investigate the dynamical threshold which is the microscopic analog of the macroscopic extra-push threshold. We find that, for head-on collisions at bombarding energies above the interaction barrier, the onset of fusion is extremely sensitive to the interaction used. The thresholds calculated with different Skyrme forces differ by several hundreds of MeV or more, and are related to the effective mass of the interaction. We also show that the high-energy angular momentum window threshold has a pronounced force dependence, a feature which must be properly taken into account in comparing time-dependent Hartree-Fock window predictions with experimental data. Finally, it is shown that the fusion behavior can be sensitive both to the numerical time step used and to the precision of the calculation, a problem which may have implications regarding the validity of the time-dependent Hartree-Fock results after time scales of the order of 10^{-20} s.

23257 **Relativistic (Dirac equation) effects in microscopic elastic scattering calculations.** Hynes, M.V.; Picklesimer, A.; Tandy, P.C.; Thaler, R.M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 4, 1438-1463(Apr 1985).

A simple relativistic extension of the first-order multiple scattering mechanism for the optical potential is employed within the context of a Dirac equation description of elastic nucleon-nucleus scattering. A formulation of this problem in terms of a momentum-space integral equation displaying an identifiable nonrelativistic sector is described and applied. Extensive calculations are presented for proton scattering from ^{40}Ca and ^{16}O at energies between 100 and 500 MeV. Effects arising from the relativistic description of the propagation of the projectile are isolated and are shown to be responsible for most of the departures from typical nonrelativistic (Schroedinger) results. Off-shell and nonlocal effects are included and these, together with uncertainties in the nuclear densities, are shown not to compromise the characteristic improvement of forward angle spin observable predictions provided by the relativistic approach. The sensitivity to ambiguities in the Lorentz scalar and vector composition of the optical potential is displayed and discussed.

23258 **Interplay of resonant and l-window background amplitudes in $^{16}O+^{16}O$.** Gai, M.; Korotky, S.K.; Manoyan, J.M.; Schloemer, E.C.; Shivakumar, B.; Sterbenz, S.M.; Willett, S.J.; Bromley, D.A.; Voit, H. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 4, 1255-1267(Apr 1985). Contract AC02-76ER03074.

High resolution study of the $^{16}O+^{16}O$ system at 15.5 < or =E/sub c.m./< or =17.0 MeV is reported including excitation functions for elastic scattering, and angle integrated cross sections for α_0 and α_1 exit channels and several γ-ray channels. All show correlated resonant structure. Fifteen angular distributions for the α_0 and α_1 exit channels are measured in ΔE/sub c.m./≅50 keV steps for 15.5< or =E/sub c.m./< or =16.4 MeV in the angular range 17°< or =θ/sub c.m./< or =93° in steps of Δθ/sub c.m./ ≅2.5°. Phase shift analysis of the α_0 angular distribution was carried out. Ambiguities in the extraction of the S matrix elements are removed using the usual techniques with an additional new constraint: the measurement of cross section at selected angles (zeros of P/sub l/) arising from a single partial wave. Reaction amplitudes corresponding to a narrow l window around the grazing partial wave are shown to dominate the cross section around θ/sub c.m./ = 90°. The grazing partial wave shows broad nonresonant structure; a specific parametrization of the energy dependence of the nonresonant (background) cross section corresponding to the l window is presented. The interplay of background amplitudes (l window) and resonant amplitudes is emphasized. Resonances in the α_0 channel are located at E/sub c.m./ = 15.8, 15.9, and 16.1 MeV having J/sup π/ = 10^+, 8^+, and 8^+, respectively, and intermediate widths (Γ~70 keV).

23259 **Pion single charge exchange on ^7Li at low energies.** Irom, F.; Baer, H.W.; Bowman, J.D.; Cooper, M.D.; Piasetzky, E.; Sennhauser, U.; Ziock, H.J.; Leitch, M.J.; Erell, A.; Moinester, M.A.; Comfort, J.R. (Arizona State University, Tempe, Arizona 85287 and Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 4, 1464-1467(Apr 1985).

Forward-angle differential cross sections for the isobaric-analog-state transition, $^7Li(\pi^+,\pi^0)^7Be$, were measured at 33.5, 41.1, 48.7, and 58.8 MeV. A minimum in the excitation function of ^7Li at 42.3 +- 1 MeV reflects the analogous minimum in the free πN cross section, which, according to current phase-shift analyses, is between 45 and 50 MeV. The data are compared with optical-model calculations.

6514 Nuclear Properties And Reactions, A=20-38

23260 **Lifetimes of levels in ^{25}Na and /sup 26,27/Mg excited via the ^{26}Mg bombardment of ^3H.** Kozub, R.L.; Fields, D.J.; Chitwood, C.B. Jr.; Alexander, T.K.; Ball, G.C.; Forster, J.S.; Mak, H.B.; McLatchie, W. (Tennessee Technological Univ., Cookeville). *Nuclear Physics* [*Section*] *A;* **A403**: 155-165(1983).

Lifetimes have been measured for nine levels in ^{25}Na, the first two excited states of ^{27}Mg, and the first excited state of ^{26}Mg by bombarding a Ti^3H target with 40 MeV ^{26}Mg ions. Mean lifetimes were determined by fitting the Doppler-broadened γ-ray lineshapes with lineshapes calculated using experimentally-measured stopping powers. The ^{25}Na results are compared to predictions of recent shell-model calculations.

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 65151023257, 23271

23261 βi decay of ^{47}Cr. Burrows, T.W.; Olness, J.W.; Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1490-1493(Apr 1985).

The β^+ decay of ^{47}Cr (J/sup π/,T = (3/2)$^-$,(1/2)) has been studied following its production by the ^{9}Be(^{40}Ca, 2n)^{47}Cr reaction at E(^{40}Ca)roughly-equal90 MeV. In addition to the previously reported superallowed decay to the mirror state (i.e., the ^{47}V ground state), we observe a (3.7 +- 1.2)% allowed β^+ branch to the (5/2)$^-$ state at 87 keV in ^{47}V. These two branches appear to dominate the decay of ^{47}Cr; an upper limit of less than 0.5% is set on possible γ rays, other than the 87-keV γ ray, in the range of 15 to 2800 keV. Measurement of the time decay of the 87-keV γ ray establishes a value of T/sub 1/2/ = 508 +- 10 ms for the ^{47}Cr half-life which is in significant disagreement with two previously reported values. The present work utilized Ge spectroscopy and a He-jet system for transport of the beam-induced radioactivity, as opposed to previous measurements which used a plastic scintillator to detect positrons and either a He-jet chopper or a slow beam-pulsing system. A summary of decay data for the complete f/sub 7/2/ shell series of mirror nuclei is also presented.

23262 High spin states of ^{86}Zr. Warburton, E.K.; Lister, C.J.; Olness, J.W.; Haustein, P.E.; Saha, S.K.; Alburger, D.E.; Becker, J.A.; Dewberry, R.A.; Naumann, R.A. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1211-1219(Apr 1985).

The level scheme of ^{86}Zr was studied by in-beam measurements on γ transitions in the ^{60}Ni(^{30}Si,2pnγ)^{86}Zr reaction and by helium-jet studies of delayed γ-ray activity from the ^{58}Ni(^{32}S,3pn)^{86}Nb(β^+/EC)^{86}Zr reaction. In the latter study, measurements consisted of γ-γ and β-γ coincidences, excitation functions, and a lifetime determination. An ^{86}Nb decay scheme was obtained which suggests J/sup π/ = 5$^+$ for the ^{86}Nb ground state. The in-beam study consisted of γ-γ coincidences, excitation functions, angular distributions, and lifetime measurements via both Doppler shift attenuation and recoil distance methods. The high-spin decay scheme and level lifetimes obtained from the in-beam studies suggest intrinsic modes of excitation rather than the collective behavior seen in ^{84}Zr.

6516 Nuclear Properties And Reactions, A=59-89

23263 Precompound decay calculations for reactions induced by 10—100 MeV/nucleon heavy ions. Blann, M. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1245-1254(Apr 1985).

The Boltzmann master equation model has been applied to the question of precompound nucleon deexcitation of reactions induced by 10—100 MeV/nucleon (c.m.) heavy ions. Test systems of ^{16}O+ ^{60}Ni and ^{27}Al+ ^{86}Kr were selected. Experimental neutron spectra in coincidence with evaporation residue and fission fragments from the ^{20}Ne+ ^{165}Ho system (due to Holub et al.) were reproduced quite well by the master equation with exciton numbers between 20 and 23. Exciton values of projectile mass and projectile mass plus 3 were therefore used in the extrapolations of the master equation. Results show major fractions of the excitation and up to 35 nucleons removed during the coalescence-equilibration period. The linear momentum transfer predicted by the master equation is shown to be in good agreement with a broad range of data. Calculations are provided as to the range of angular momenta which may be carried off by the precompound cascade.

6517 Nuclear Properties And Reactions, A=90-149

23264 (DOE/ER/40162—1) Light particle emission measurements in heavy ion reactions. Annual progress report, June 1, 1984-May 31, 1985. Petitt, G.A. (Georgia State Univ., Atlanta (USA). Dept. of Physics and Astronomy). 1985. Contract FG05-84ER40162. 17p. NTIS, PC A02. File Number DE85009319.

The Georgia State University program of research in light particle emissions from products of heavy ion reactions is completing another successful year under the sponsorship of the Division of High Energy and Nuclear Physics of the US Department of Energy. Our work has included continued participation in neutron emission measurements at the Hollifield Heavy Ion Research Facility (HHIRF) and a collaboration with colleagues from the Hahn Meitner Institute, the University of Lyon and University of Grenoble in neutron emission measurements at the SARA facility in Grenoble. A paper on our work at the Hollifield facility on neutron emissions from products of inelastic scattering reactions from products of the ^{12}C + ^{152}Gd and ^{20}Ne + ^{150}Nd reactions has been completed and is ready for submission to Physical Review C. We have continued our position sensitive detector development; the evaporation residue (ER) detector that we reported on last year has been completed and tested and is ready for use; and finally, the 80 cm neutron target chamber on which we have been working in collaboration with the ORNL group was completed during the year and used successfully in an experiment at the HHIRF.

6518 Nuclear Properties And Reactions, A=150-189

23265 Search for the decay of ^{180}Ta/sup m/. Cumming, J.B.; Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1494-1498(Apr 1985).

A sample of Ta_2O_5 containing 151 mg of Ta enriched to 5.47% in ^{180}Ta/sup m/ was counted in a well-type high-purity Ge detector. This was enclosed in a large NaI(Tl) detector operated in anticoincidence to reduce the cosmic-ray continuum background. Several runs of ~100 days each were made under different conditions to search for γ-ray singles or summing peaks that would follow the electron capture decay of ^{180}Ta/sup m/ to ^{180}Hf or the β^- decay to ^{180}W. Lower limits derived were T/sub 1/2/>3.0 x 10^{15} yr, log$_6$t>22.9 for electron capture decay and T/sub 1/2/ >1.9 x 10^{15} yr, log$_6$t>21.3 for β^- decay. The total half-life of ^{180}Ta/sup m/ is therefore T/sub 1/2/>1.2 x 10^{15} yr.

23266 Nuclear data sheets for A = 171. Shirley, V.S. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Nuclear Data Sheets;* **43**: No. 2, 127-244(Oct 1984). Contract AC03-76SF00098.

Experimental data pertaining to all nuclei with mass number A = 171 have been evaluated. Level schemes from both radioactive decay and reaction studies are presented, along with associated tables of experimental data and adopted properties for levels and transitions.

6519 Nuclear Properties And Reactions, A=190-219

REFER ALSO TO CITATION(S) 65191023287

23267 Fission of heavy nuclei induced by energetic pions. Hicks, K.H.; Jeppesen, R.G.; Kraushaar, J.J.; Kunz, P.D.; Peterson, R.J.; Raymond, R.S.; Ristinen, R.A.; Ullmann, J.L.; Becchetti, F.D.; Bradbury, J.N.; Paciotti, M. (Nuclear Physics Laboratory, Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1323-1333(Apr 1985).

Fission of ^{238}U, ^{209}Bi, and ^{197}Au induced by both positive and negative pion beams at incident energies of 60 to 100 MeV is examined. Energy and mass spectra and angular correlations of coincident fission fragments are compared to theoretical calculations and to other data. Excitation energies of the fissioning system in excess of 100 MeV are deduced, implying that the fission examined

in this study is caused primarily by true absorption of the pion. The masses of the coincident fission fragments are found to have a wider distribution than those from fissioning systems of similar excitation energy induced by nucleon beams. The fission cross sections are close to the reaction cross sections for ^{238}U and scale with the fissility for the other nuclei studied.

23268 **Nuclear data sheets for A = 207.** Schmorak, M.R. (Oak Ridge National Laboratory P.O. Box X Oak Ridge, Tennessee 37830, USA). *Nuclear Data Sheets;* **43**: No. 3, 383-479(Nov 1984). Contract AC05-84OR21400.

Experimental data pertaining to nuclear structure of nuclei with mass number A = 207 have been compiled and evaluated.

6520 Nuclear Properties And Reactions, A=220 And Above

23269 **Nuclear-charge distribution for A = 121 from thermal-neutron-induced fission of ^{235}U.** Robinson, L.; Wahl, A.C.; Semkow, T.M.; Norris, A.E. (Department of Chemistry, Washington University, St. Louis, Missouri 63130). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1334-1339(Apr 1985).

The fractional cumulative yield of ^{121}Ag and the fractional independent yields of ^{121}Cd, ^{121}In, and ^{121}Sn from thermal-neutron-induced fission of ^{235}U were determined radiochemically to be 0.12 +- 0.05, 0.61 +- 0.09, 0.24 +- 0.08, and 0.03 +- 0.04, respectively. The yield values were used to determine the nuclear-charge-distribution parameters σ/sub Z/ = 0.55 +- 0.10 and ΔZ = 0.50 +- 0.05 for A = 121. The σ/sub Z/ for A = 121 is close to σ/sub Z/ $ = 0.52 +- 0.02 for high-yield fission products, and no evidence for an even-odd Z effect was found for A = 121. The positive ΔZ value, which corresponds to Z/sub P/ = 48.15, is similar to those for several higher mass numbers reported previously, and it is considerably greater than the negative values predicted by the scission-point theoretical model. The use of a separation distance between nascent fragments greater than 1.4 fm, the value used in the theoretical calculations, could reduce the discrepancy and could also account for the observed enhanced independent yields of tin fission products with Z/sub P/ near 50 (A = 126—129).

6530 Nuclear Theory

23270 **(LBL—19032) Soliton matter as a model of dense nuclear matter.** Glendenning, N.K. (Lawrence Berkeley Lab., CA (USA)). Jan 1985. Contract AC03-76SF00098. 18p. (CONF-850141—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009937.

From 13. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1985).

We employ the hybrid soliton model of the nucleon consisting of a topological meson field and deeply bound quarks to investigate the behavior of the quarks in soliton matter as a function of density. To organize the calculation, we place the solitons on a spatial lattice. The model suggests the transition of matter from a color insulator to a color conductor above a critical density of a few times normal nuclear density. 9 references, 5 figures.

23271 **Meson theory of the dirac impulse approximation.** Tjon, J.A.; Wallace, S.J. (Theoretical Division and Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **54**: No. 13, 1357-1360(1 Apr 1985). Contract AS05-76ER05126.

A new formulation of the dirac impulse approximation is discussed which connects the p-nucleus optical potential to a dynamical description of the relativistic NN amplitude. Use of pseudovector πN coupling eliminates rapid energy dependence found in the original impulse approximation. First calculations demonstrate success for 181 MeV with no loss of effectiveness at 500 and 800 MeV.

23272 **Systematics of fission fragment total kinetic energy release.** Viola, V.E.; Kwiatkowski, K.; Walker, M. (Department of Chemistry and Indiana University Cyclotron Facility, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1550-1552(Apr 1985).

Recent data for the most probable total kinetic energy release in fission <E/sub K/> have been combined with earlier results in order to reevaluate the systematic dependence of these values on the Coulomb parameter Z^2/A/sup 1/3/. A least-squares analysis of the current data base yields <E/sub K/> = 0.1189Z^2/A/sup 1/3/+7. 3 MeV, where Z^2/A/sup 1/3/ refers to the fissioning nucleus. This expression exhibits a somewhat steeper slope than previous fits.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 65400022863

23273 **(AD-A—148904/6/XAB) Hydrodynamic response of a radiating Al plasma excited by a proton beam. Memorandum report.** Rogerson, J.E.; Clark, R.W.; Davis, J. (Naval Research Lab., Washington, DC (USA)). 20 Dec 1984. 55p. (NRL-MR—5482). NTIS, PC A04/MF A01.

A fully self-consistent one-dimensional ion beam-slab interaction model has been developed which describes the slowing down of the beam, the hydrodynamic response and ionization dynamics of the slab, and detailed radiation emission and transport. An extensive atomic level structure with collisional radiative ionization dynamics is employed in conjunction with a hybrid radiation-transport scheme which consists of a multifrequency formalism for continuum transport and a probabilistic treatment for line transport. It is found that beam deposition and slab response depend strongly on radiation transport within the slab. Temperature and density profiles and emission spectra are presented.

23274 **(ANL—83-100-Pt.1) Environmental Research Division: fundamental molecular physics and chemistry. Annual report, January-December 1983. Part I.** (Argonne National Lab., IL (USA)). Mar 1985. Contract W-31-109-ENG-38. 126p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85009364.

Research progress is reported in the following areas: (1) photoionization of radicals or excited states; (2) molecular spectroscopy by resonant multiphoton ionization; (3) studies conducted with the synchrotron radiation facility at the National Bureau of Standards; (4) theoretical studies on molecular photoabsorption; (5) analysis of photoabsorption spectra of open-shell atoms; (6) the electron energy-loss spectra of molecules; and (7) cross sections and stopping powers. Items have been individually abstracted for the data base. (ACR)

23275 **(LA—10272-MS) Electron multiple, plural, and single scattering.** Devaney, J.J. (Los Alamos National Lab., NM (USA)). Mar 1985. Contract W-7405-ENG-36. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010325.

The angular distribution of a beam of electrons penetrating in infinite slab is studied with a view to providing simple accurate formulae for use in electron transport codes. We report success, but a highly disappointing success, for although the literature is vast, (over 150 papers), the experiments are limited, sparse, and often poorly described. The theory suffers from complexity, from incomplete, erroneous, or even absent comparisons with other theories and with experiment. Consequently, we cannot say with any assurance what the best theory is, nor to any great accuracy, especially in limiting cases, how good the theory we recommend is. We do give comparisons with the experiments known to us. With that caveat, we recommend the theory of Moliere as given by Bethe and by Hanson et al. Formulas are given. We expect accuracies of a few percent for multiple scattering. For the (in the cases studied) less dominant concomitant plural and single scattering the theory cannot do better than 10 to 30%. Because of the complexity of the functions, either series or tables must be employed. A bright spot in

this somewhat gloomy state of affairs is the calculation of the 1/e width which can be done accurately (≦ 2%) by a simple approximation due to Hanson et al. Using theories of Hanson et al. and variants thereof, an approximate Gaussian gives a good (7 to 20% error) simple description of the multiple scattering. Approximate single scattering formulas are also offered. 25 references, 6 tables.

23276 **Electron-velocity distribution functions in gases: The influence of anisotropic scattering and electron nonconservation by attachment and ionization.** Blevin, H.A.; Fletcher, J.; Hunter, S.R. (Institute for Atomic Studies, School of Physical Sciences, The Flinders University of South Australia, Bedford Park, South Australia 5042, Australia). *Physical Review* [*Section*] *A: General Physics;* **31**: No. 4, 2215-2226(Apr 1985).

Electron-velocity distribution functions have been calculated for electrons moving in a gas under the influence of an electric field. By assuming a differential scattering cross section such that scattering is entirely at 0° and 180°, it is shown analytically that the electron drift velocity w, the mean electron energy <ϵ>, the transverse diffusion coefficient D/sub T/, and the longitudinal diffusion coefficient D/sub L/ are not, in general, determined by the momentum-transfer cross section alone. The magnitude of the errors incurred by neglecting the higher-order terms in the spherical-harmonic expansion of the velocity distribution function for this collision model are indicated. Velocity distribution functions have also been calculated for attaching gases. It is found that the velocity distribution function can be considerably altered by attachment for pure gases and gas mixtures. Consequently, any attempt to determine collision cross sections from electron-swarm measurements of w, D/sub T/, and D/sub L/ in attaching gases should include attachment processes in the solution of the Boltzmann equation. The magnitude of this dependence has been found to be determined largely by the ratio of the attachment collision frequency to the energy-transfer collision frequency and the velocity dependences of the momentum transfer and attaching collision frequencies.

6550 Medical Physics

REFER ALSO TO CITATION(S) 65500023124

23277 **(PB—85-120640) NBS (National Bureau of Standards) standard reference neutron fields for personnel dosimetry calibration. Final report.** Schwartz, R.B.; Grundl, J.A. (National Bureau of Standards, Washington, DC (USA)). 1978. 19p. Published in Proc. Natl. and Int. Standardization of Radiation Dosimetry, Atlanta, Georgia, December 5-9 1977, p. 367-375.

Sponsored in part by International Atomic Energy Administration, Washington, DC.

The National Bureau of Standards (NBS) has established and characterized several neutron fields for dosimeter calibration. Two of these fields are continuous neutron spectra: the spontaneous fission neutron distribution from ^{252}Cf, and a thermal Maxwellian beam. The other three neutron fields are monoenergetic reactor beams with energies of 2, 24, and 144 keV.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 65600023233

23278 **(DOE/ER/45080—T1) Local density theory of heats of formation and short-range order parameters in substitutionally disordered alloys. First year report.** Freeman, A.J.; Gonis, A. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy). 1985. Contract FG02-84ER45080. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009811.

Objective is to calculate short-range-order effects and phase diagrams in substitutionally disordered alloys of transition metals and actinides. During this period, a general unified method was formulated for calculating the Green functions associated with atoms in crystalline matter displaced from the regular lattice positions.

23279 **Thermodynamic self-consistency for hard spheres at low density.** Siders, P.; Kozak, J.J. (Radiation Laboratory and Department of Chemistry, University of Notre Dame, Notre Dame, Indiana 46556). *Journal of Chemical Physics;* **82**: No. 9, 4257-4263(1 May 1985).

We consider the conditions on the triplet-distribution function g/sup(/³)/sup /, and the pair-distribution g/sup(/²)/sup /, sufficient that thermodynamic quantities calculated from g/sup(/³)/sup / be state functions. We show that g/sup(/³)/sup / cannot be, even to first order in density, equivalent to the Kirkwood superposition approximation. We obtain a g/sup(/³)/sup / that does yield a thermodynamically self-consistent g/sup(/³)/sup /, to second order in density. We show that this g/sup(/³)/sup / differs little from the exact g/sup(/³)/sup /, at that order. We also examine the low-density behavior of a partially self-consistent closure in which angular correlations appear explicitly. The latter closure is found to describe three-particle correlations well when two of the particles are in contact. A principal conclusion which follows from these studies is that the criterion of thermodynamic self-consistency is useful as a constraint in constructing closures, although it does not in itself determine a closure.

6561 Superconductivity

REFER ALSO TO CITATION(S) 65610022855, 22856, 22857

23280 **Effective constants for wave propagation through partially saturated porous media.** Berryman, J.G.; Thigpen, L. (Lawrence Livermore National Laboratory, University of California, P. O. Box 808, L-201, Livermore, California 94550). *Applied Physics Letters;* **46**: No. 8, 722-724(15 Apr 1985).

The multipole scattering coefficients for elastic wave scattering from a spherical inhomogeneity in a fluid-saturated porous medium have been calculated. These coefficients may be used to obtain estimates of the effective macroscopic constants for long-wavelength propagation of elastic waves through partially saturated media. If the volume average of the single scattering from spherical bubbles of gas and liquid is required to vanish, the resulting equations determine the effective bulk modulus, density, and viscosity of the multiphase fluid filling the pores. The formula for the effective viscosity during compressional wave excitation is apparently new.

23281 **Green's function solution of the Kondo problem and universality of the thermodynamic properties (invited).** Arai, T. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **57**: No. 8, 3161-3165(15 Apr 1985).

Using a functional derivative approach, we derive, for the nondegenerateAnderson model of dilute magnetic alloys, a Green's function, which is valid atall temperatures and which accurately exhibits the Kondo effect. This is madepossible by explicitly satisfying the Baym criterion for the macroscopicconservation of particle-number, momentum and energy: a criterion not satisfied by any of the earlier Green's function treatments of the Kondo model or the Anderson model. The free energy of the system is calculated and the universality of all the thermodynamic properties including resistivity is analytically demonstrated. The temperature-dependent susceptibility chi(T) and specific heat C(T) thus calculated are found to be almost indistinguishable from the results of the renormalization group theory.

23282 **Irreversibility in diluted antiferromagnets.** Soukoulis, C.M.; Grest, G.S.; Ro, C.; Levin, K. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50010). *Journal of Applied Physics;* **57**: No. 8, 3300-3302(15 Apr 1985).

We compute the irreversibility phase diagram, and history-dependent magnetizations for diluted Ising antiferromagnets in three dimensions. We use an iterative mean-field technique which has proved quite successful for treating spin glasses. Motion of the domain walls as the magnetic field is varied at low temperature is also discussed. The onset of time-dependent long-range order and magnetization anomalies are predicted for certain regions of the H-

T phase diagram from our studies of the free-energy surface. Our results are compared to those of the random field ferromagnet and spin glasses, which have the common feature that on the time scale of a physical measurement the system is trapped in a local minimum of the free-energy surface. Irreversibility then results primarily from the disappearance of a given minimum as the field or temperature are changed and not from tunneling or thermal activation processes.

23283 **Deterministic hopping in a Josephson circuit described by a one-dimensional mapping.** Miracky, R.F.; Devoret, M.H.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **31**: No. 4, 2509-2519(Apr 1985).

Analog simulations of the hopping noise of a current-biased Josephson tunnel junction shunted with an inductor in series with a resistor reveal a $1/\omega$ spectral density over two decades of frequency ω for a narrow range of bias currents. The amplitude of the low-frequency part of the spectrum decreases when white noise, representing Nyquist noise in the resistor at a few degrees Kelvin, is added to the simulation. We explain the shape of the power spectrum and its dependence on bias current and added white noise in terms of a deterministic process, involving a one-dimensional mapping, that is analogous to that found in Pomeau-Manneville intermittency. Moreover, we are able to establish a detailed relationship between the origin of the mapping and the differential equation describing the dynamics of the system.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 65700023249

23284 **(LYCEN—8356) Motion of a particle in a ring-shaped potential: an approach via a nonbijective canonical transformation.** Kibler, M.; Negadi, T. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Oran Univ. (Algeria). Inst. de Physique). Nov 1983. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901228.

The problem of a particle in three-dimensional ring-shaped potential eta $\sigma^2(2\ a_0/r$ - eta $a_0^2/r^2\ \sin^2\theta)\ \epsilon_0$ introduced by Hartmann is transformed into the problem of a coupled pair of two-dimensional harmonic oscillators with inverse quadratic potentials by using a nonbijective canonical transformation, viz., the Kustaanheimo-Stiefel transformation. The energy E of the levels for the ring-shaped potential is obtained in a straightforward way from the one for the two-dimensional potential -(4 E rho^2 + eta$^2\sigma^2$a/sub o/ $^2\epsilon_0$/rho^2).

23285 **Hybrid boundary-volume Galerkin's method for nonlinear magnetostatic problems.** Mayergoyz, I.D.; Doong, T. (Electrical Engineering Department, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **57**: No. 8, 3838-3840(15 Apr 1985).

The paper describes a new technique for the solution of nonlinear magnetostatic problems. It is based on the reduction of field equations to two coupled boundary and volume Galerkin's forms. A hybrid finite-quasifinite element discretization of these Galerkin's forms is proposed. It leads to sets of simultaneous equations with symmetric matrices. This technique is also free from the other difficulties encountered in the mutually constrained differential-integral equation approach. Some numerical results obtained by this technique are reported.

23286 **Chinea responds.** Chinea, F.J. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973 and Departamento de Metodos Matematicos, Facultad de Ciencias Fisicas, Universidad de Madrid, Madrid 28040, Spain). *Physical Review Letters;* **54**: No. 14, 1595-1595(8 Apr 1985). Contract AC02-76CH00016.

A reply to the comment on Einsteins equation in vacuum as integrability conditions for Newman Penrose equations is presented.(AIP)

23287 **Class of exactly solvable potentials II. A three-dimensional Schroedinger equation.** Ginocchio, J.N. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Annals of Physics (New York);* **159**: No. 2, 467-480(Feb 1985).

The three-dimensional Schroedinger equation with an effective mass is solved for a new class of angular momentum dependent potentials with varying depths and shapes. The energy eigenvalues and resonances are given in algebraic form as a function of the effective mass and depth and shape of the potential. The eigenfunctions, scattering function, and Green's function are given in closed form in terms of known special functions. The charge density of ^{208}Pb is calculated using eigenfunctions of a potential and this charge density is compared to the measured charge density.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 65800023225, 23285

23288 **Assessment of Fisher and logistic linear and quadratic discrimination models.** Bayne, C.K.; Beauchamp, J.J.; Kane, V.E.; McCabe, G.P. (Union Carbide Corp., Oak Ridge, TN). *Computational Statistics and Data Analysis;* **1**: 257-273(1983). Contract W-7405-ENG-26.

This paper summarizes the results from a study comparing the performance of the Fisher and logistic linear and quadratic discriminant functions. Three types of bivariate distributions are studied. Each classification rule is compared to the optimal maximum likelihood procedure for the different data types. The theoretical misclassification probabilities of the sample discriminant functions are calculated directly and used for the comparison of the different procedures both in terms of bias and variation. Generalizations and recommendations are made to assist the applied statistician in making the correct choice of a discrimination procedure and the results of this study are compared with earlier investigations. This study shows that specification of the form of the discriminant function may be one of the most important parts of a discriminant analysis.

23289 **Influence of solitons in the initial state on chaos in the driven damped sine-Gordon system.** Bishop, A.R.; Fesser, K.; Lomdahl, P.S.; Trullinger, S.E. (Los Alamos National Lab., NM). *Physica D: Nonlinear Phenomena (Amsterdam);* **7D**: 259-279(1983).

The appearance of chaos in the a.c. driven, damped sine-Gordon equation is studied numerically. Several transitions from periodic to chaotic behavior are investigated in detail for flat initial conditions. Spatial structures (breather, kink) in the initial conditions smooth out many of these transitions and give rise to an interesting symbiosis of time and spatial intermittency. This symbiosis appears to be due to the competition between the background tendency towards chaos and the system's preference to maintain a spatial pattern. The way that this competition is relieved is also found to depend very strongly on symmetry in the initial conditions.

23290 **Theory of exact and approximate configurational invariants.** Hall, L.S. (Lawrence Livermore National Lab., CA). *Physica D: Nonlinear Phenomena (Amsterdam);* **8D**: 90-116(1983). Contract W-7405-ENG-48.

A theory of integrable Hamiltonian systems in two dimensions is formulated and applied. The four-dimensional phase-space problem that is the vanishing of the Poisson bracket between another invariant and the Hamiltonian is here reduced to the solution of a series of two-dimensional configuration-space equations. (The theory is also applicable to more than two dimensions.) The constraints are found which admit to integrability of the orbits for magnetic or Coriolis forces as well as for forces derivable from a potential. When a system admits a given invariant, the invariant is found - for example, by quadrature. A number of examples including known and apparently previously unknown invariants are given. The theory of exact integrals of the motion also can be extended to the derivation of approximate invariants. The orbital structure of integrable or approximately integrable systems correlates with the degree (maximum power of the velocity) of a stand-

ardized invariant. The theory admits a variational principle, among other approximation techniques, for the computation of a best approximate invariant. The problem of the general cubic potential with one symmetric coordinate, $V = 1/2Ax^2 + 1/2By^2 + Cx^2y + 1/3Dy^3$, (of which the well-studied Henon-Heiles potential is the special case for A = B and C = -D) is examined in detail.

70 FUSION ENERGY

23291 (DOE/ER—0214) Magnetic Fusion Program Plan. (USDOE Office of Energy Research, Washington, DC). Feb 1985. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009861.

This Plan reflects the present conditions of the energy situation and is consistent with national priorities for the support of basic and applied research. It is realistic in taking advantage of the technical position that the United States has already established in fusion research to make cost-effective progress toward the development of fusion power as a future energy option.

7001 Plasma Research

REFER ALSO TO CITATION(S) 70010023208, 23209, 23355, 23355

23292 (AD-A—148040/9/XAB) Research proposal for the theoretical study of the thermodynamic and transport properties of dense plasmas. Final report, 15 June 1979-30 September 1984. Rogers, F.J.; DeWitt, H.E.; Boercker, D.B. (Lawrence Livermore National Lab., CA (USA)). 20 Nov 1984. Contract W-7405-ENG-48. 13p. (UCID—20265). NTIS, PC A02/MF A01.

A basic theoretical study of the equation of state and transport properties of dense, partially ionized, reacting plasmas has been carried out. This report summarizes the work which is fully described in 14 journal articles, and reports. Topics include Dense Plasmas, Equation of State, Electrical Conductivity, Structure Factors, Pair Distribution Functions, Pseudopotentials, Effective Potentials, Partially ionized plasmas.

23293 (AD-A—149389/9/XAB) Generation of Alfven waves due to thermal modulation of the electrical conductivity. Shoucri, M.M.; Morales, G.J.; Maggs, J.E. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Nov 1984. 34p. (PPG—830). NTIS, PC A03/MF A01.

An analytic study is made of the effects produced by a localized modulation of the electrical conductivity of a magnetized plasma carrying a field-aligned current. The modulation is assumed to be caused by a heating source external to the plasma. The formulation used is applicable to modulation frequencies, omega, below the ion cyclotron frequency omega sub ci, and permits the calculation of the radiation pattern which contains shear as well as compressional Alfven modes, and near fields. For omega/omega sub ci $<<1$, the radiation appears primarily in the form of a highly collimated shear mode travelling along the field lines passing through the spot where the modulation occurs.

23294 (AD-A—149451/7/XAB) Simulation of the ion-beam-driven drift instability in a magnetic trap I. Memorandum report. Thomas, V.A.; Nevins, W.M.; Chen, Y.J. (California Univ., Berkeley (USA). Electronics Research Lab.). 13 Jun 1984. 71p. (UCB/ERL-M—84/45). NTIS, PC A04/MF A01.

See also AD-A149 452.

Recent experiments on the TMX-U device at LLNL have indicated the possibility of a drift wave being driven unstable by the injection of neutral beams in the thermal-barrier region. A review of linear theory is presented in the local approximation. In addition, particle-simulations are used to understand the nonlinear characteristics of this instability. The particle simulations are performed using 1d - 3v and 2d - 3v electrostatic particle simulation codes. The instability is shown to saturate by beam trapping, nonlinear electron effects, and nonlinear motion parallel to the density gradient. Resonant E x B motion is a significant process for some of the beam particles. This process is closely associated with the trapping of beam ions. Harmonic generation is also observed, as appears in some of the experimental data. Qualitative nonlinear theory is presented in support of the particle simulations.

23295 (AD-A—149452/5/XAB) Simulation of the ion-beam-driven drift instability in a magnetic trap II. Memorandum report. Thomas, V.A.; Nevins, W.M.; Chen, Y.J. (California Univ., Berkeley (USA). Electronics Research Lab.). 13 Jun 1984. 49p. (UCB/ERL-M—84/46). NTIS, PC A03/MF A01.

See also AD-A149 451.

Recent experiments on the TMX-U device at LLNL have indicated the possibility of a low-frequency drift wave being driven unstable by the injection of neutral beams in the thermal barrier region. Nonlocal linear theory is performed for this instability using slab geometry and the electrostatic approximation. Particle simulations are used to verify the linear theory and to recover relevant nonlinear phenomena. Important nonlinear effects include: (1) E x B trapping, (2) relaxation of the beam density profiles, and (3) weakly nonlinear electrons.

23296 (ANL/FPP/TM—201) Low plasma edge temperatures for the self-pumped limiter. Terry, W.K.; Brooks, J.N. (Argonne National Lab., IL (USA)). Mar 1985. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010155.

Transport code calculations have been performed to study the operation of an INTOR-like tokamak plasma from which helium is removed by a self-pumped limiter, which traps helium, but not hydrogen, in its surface layers. To prevent saturation by helium, the surface is renewed by continuous injection of the surface material (vanadium in this study) into the scrape-off layer. The presence of the injected vanadium leads to plasma temperatures well below 50 eV in the scrape-off layer, with supplementary rf heating. Operation in this edge temperature regime is essential for the use of medium- and high-Z limiter coatings.

23297 (DOE/ER/10275—1B, pp 70) Convenient integration techniques to evaluate the reactivities of Maxwellian plasmas. Wallace, C.; Law, W.; Chung, A. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23298 (DOE/ER/10275—1B, pp 72) Large energy transfer collisions for hardening fusion plasmas. Stroud, P.D. (Univ. of Illinois, Urbana). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23299 (DOE/ER/53169—T1) Simulations of fusion plasmas by a 3D, E-M particle code. Final report, 1 January 1984-31 December 1984. Buneman, O. (Stanford Univ., CA (USA). Space, Telecommunications and Radioscience Lab.). Mar 1985. Contract FG03-84ER53169. 5p. NTIS, PC A03. File Number DE85008642.

A very brief report on the numerical simulation research is given in relation to development and student training. (MOW)

23300 (DOE/ET/53088—168) Covariant Poisson brackets for classical fields. Marsden, J.E.; Montgomery, R.; Morrison, P.J.; Thompson, W.B. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jan 1985. Contract FG05-80ET53088. 26p. (IFSR—168). NTIS, PC A03/MF A01; GPO Dep. File Number DE85010085.

Poisson brackets that are covariant under spacetime coordinate changes are presented for relativistic field theories. The formalism described here is an alternative to the sympletic formulation of field theories and has several advantages. It applies to relativistic fluids and plasmas written in Eulerian variables, while the symplectic formulation does not. It is expected to simplify and clarify the transition to the dynamical (or 3+1) Hamiltonian formalism as well.

23301 (ORNL/Sub—7676/5) Research support for plasma diagnostics on Elmo Bumpy Torus: diamagnetic measurements and data analysis, and development of ring models for realistic representation of fields near the plasma. Carpenter, K.H.; Steimle, R.F. (Missouri Univ., Rolla (USA). Dept. of Electrical Engineering). Oct 1984. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010035.

Theoretical and experimental studies relating to the diamagnetism of the EBT electron rings have contributed to a better understanding of ring energy and geometry. The primary experimental effort during the past year was the taking of data using the UMR Hall Effect Diamagnetic Diagnostic instrument with the probes mounted along the horizontal midplane at the large major radius position of an EBT cavity. Analysis of this data has confirmed earlier indications of an electron ring component being present near the cavity wall.

23302 (PPPL—2198) Plasma confinement. Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1985. Contract AC02-76CH03073. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85008715.

The physics of plasma confinement by a magnetic field is developed from the basic properties of plasmas through the theory of equilibrium, stability, and transport in toroidal and open-ended configurations. The close relationship between the theory of plasma confinement and Hamiltonian mechanics is emphasized, and the modern view of macroscopic instabilities as three-dimensional equilibria is given.

23303 (PPPL—2201) One millimeter wave interferometer for the measurement of line integral electron density on TFTR. Efthimion, P.C.; Taylor, G.; Ernst, W.; Goldman, M.; McCarthy, M.; Anderson, H.; Luhmann, N.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1985. Contract AC02-76CH03073. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008708.

A two-pass interferometer at 285 GHz has been developed to measure the line-integrated electron density on the horizontal midplane of the Toroidal Fusion Test Reactor (TFTR). Presently, the interferometer employs a 2 MW solid state source to supply the launch wave, a 2 mm klystron oscillator, and a harmonic mixer to provide a superheterodyne front end. The transmission system consists of 25 meters of C-band rectangular waveguide, adjustable miter bends, and a spherical mirror in the vacuum vessel with a total round trip transmission loss of 21 dB. The interferometer signal-to-noise ratio is $\geq$ 50 dB. Utilization of a feed-forward tracking system provides long-term stable operation. The interferometer routinely provides real time feedback control for the gas injection system and a permissive for neutral beam operation.

23304 (PPPL—2203) Transport in driven plasmas. Fisch, N.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1985. Contract AC02-76CH03073. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008714.

A plasma in contact with an external source of power, especially a source that interacts specifically with high-velocity electrons, exhibits transport properties, such as conductivity, different from those of an isolated plasma near thermal equilibrium. This is true even when the bulk of the particles in the driven plasma are near thermal equilibrium. To describe the driven plasma we derive an adjoint equation to the inhomogeneous, linearized, dynamic Boltzmann equation. The Green's functions for a variety of plasma responses can then be generated. It is possible to modify the Chapman-Enskog expansion in order to incorporate the response functions derived here.

23305 Collective acceleration of laser-produced ions. Cremer, J.T.; Destler, W.W. (Electrical Engineering Department and Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* 57: No. 9, 4391-4395(1 May 1985).

The collective acceleration of heavy ions (C, Al, Fe) from a laser produced plasma to energies in excess of 10 MeV/amu has been observed experimentally. In the experiments, an intense relativistic electron beam (1.2 MeV, 30 kA, 30 ns) is injected through an anode aperture into a downstream drift region. Ions to be accelerated are produced by firing a Q-switched ruby laser (0.3—15 J, 15 ns) at a target material located immediately downstream of the anode aperture. Accelerated ion energies are measured by time of flight, range-energy, and Thomson spectrometer techniques.

23306 Bounce-resonant transport of the plasma ions in a bumpy torus. Chang, C.S. (Applied Microwave Plasma Concepts, Inc., Encinitas, California 92024). *Physics of Fluids;* 28: No. 5, 1415-1418(May 1985). Contract AC03-82ER51030.

Plateau-type ion diffusion caused by the resonance between the periodic motion of the ions parallel to the magnetic field and the poloidal E x B is calculated in a bumpy torus. It is found that the loss of ion particles through this bounce resonance can be very significant when the resonance condition (Ωroughly-equalkv/sub th/) is met.

23307 Transport description of the rise time of sawtooth oscillations in reversed-field pinches. Werley, K.A.; Nebel, R.A.; Wurden, G.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* 28: No. 5, 1450-1453(May 1985).

High-Θ (ΘequivalentB/sub theta/(a)/<B/sub phi/>) toroidal reversed-field pinch discharges in the ZT-40M device are characterized by soft x-ray sawtooth oscillations. It is demonstrated that a one-dimensional transport description is sufficient to model the rise time of sawtooth oscillations, provided the resistivity profile has significant gradients. This result suggests that the toroidal magnetic flux generation (dynamo) observed in the reversed-field pinch (RFP) may be restricted to the m = 1 tearing events associated with the sawtooth crash (decrease in the soft x-ray flux).

23308 Impact of multiple-frequency heating on the formation and control of diamagnetic electron rings in an axisymmetric mirror. Quon, B.H.; Dandl, R.A.; DiVergilio, W.; Guest, G.E.; Lao, L.L.; Lazar, N.H.; Samec, T.K.; Wuerker, R.F. (TRW Electronics and Defense, Energy Research Center, One Space Park, Redondo Beach, California 90278). *Physics of Fluids;* 28: No. 5, 1503-1515(May 1985). Contract AC03-79ET51017.

High-beta, hot-electron plasmas have been produced by electron-cyclotron heating in the SM-1 axisymmetric mirror using closely-spaced multiple frequencies. The relativistic electrons produce annular distributions (ELMO rings) with as much as ten times more stored energy than with single-frequency heating. While larger frequency separations ($\Delta f/f \sim 0.1$) provide some control of the ring size, the dominant effects are associated with an improvement in heating efficiency which persists to very small frequency separations ($\Delta f/f \sim 10^{-3}$). Details of the reconstruction of the ring distribution (both in steady state and during build-up), the influence of multiple frequency heating on fluctuations, axial electron losses, and a scaling of these effects with power are presented.

23309 Z pinches with multi-ion species: Ion separation and stability. Rahman, H.U.; Amendt, P.; Rostoker, N. (Department of Physics, University of California, Irvine, California 92717). *Physics of Fluids;* 28: No. 5, 1528-1531(May 1985). Contract AC04-76DP00789.

Recent experiments on gas-puff Z pinches using various ion mixtures have demonstrated that the plasma shell separates into two distinct annuli which implode concentrically. This phenomenon is quantitatively explained with the use of a semihydrodynamic model in which the electrons are treated as a collisional fluid and the ions are considered cold and collisionless. Stabilitiy in this model is investigated and an expression for the growth rate of a Rayleigh—Taylor type instability is presented. This growth rate is found to be independent of the degree of plasma compressibility and somewhat reduced in the presence of an ion mixture. Comparison of these results with the University of California, Irvine, Z-pinch experiment is discussed.

23310 **Bounce averaged Fokker—Planck theory of non-Maxwellian tail particles.** Chiu, S.C. (GA Technologies, Inc., San Diego, California 92138). *Physics of Fluids;* **28**: No. 5, 1371-1378(May 1985). Contract AT03-84ER53158.

To take into account highly non-Maxwellian tail distributions expected in fusion and/or auxiliary heated plasmas, a self-consistent scheme of separating the non-Maxwellian tail particles from the Maxwellian bulk in the quasilinear Fokker—Planck equation is proposed. The resulting equation for tail particles is the same as that for a minority species, but with a different boundary condition at low energies. Transport fluxes of energetic particles can then be calculated as a minority species that can be easily added onto existing transport theory for the bulk species. Expressions for neoclassical fluxes of tail particles in the banana regime are obtained in terms of the solution of a steady-state minority tail distribution which takes the place of the Maxwell distribution of a bulk species. The existence of a solution is demonstrated, and simple model analytic solutions are given.

23311 **Spatial localization of bursts of the drift cyclotron loss cone instability.** Leikind, B.J.; Zwi, H.; Dimonte, G.; Wong, A.Y. (Department of Physics, University of California, Los Angeles, California 90024). *Physics of Fluids;* **28**: No. 5, 1219-1221(May 1985). Contract AT03-76ET53019.

Spatial localization of bursts of the drift cyclotron loss cone instability in a mirror machine is caused by asymmetric motion of the background plasma. The dynamic behavior of the plasma determines the appearance of the instability

23312 **High-power second harmonic emission and frequency locking in a 28-GHz gyrotron.** Danly, B.G.; Mulligan, W.J.; Temkin, R.J.; Sollner, T.C.L.G. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Applied Physics Letters;* **46**: No. 8, 728-730(15 Apr 1985).

Two important new results are presented from a study of second harmonic (2ω/sub c/) emission from a pulsed gyrotron designed for fundamental (ω/sub c/) emission of 200 kW at 28 GHz in the TE_{021} mode. Simultaneous output at $\omega_1$roughly-equalω/sub c/ and $\omega_2$roughly-equal2ω/sub c/, with the condition $\omega_2 = 2\omega_1$ applying as ω_1 was varied, has been observed for the first time. Strong, single mode 2ω/sub c/ emission (80 kW at 50 GHz) is also observed, and such emission is shown to be characteristic of gyrotrons designed for high-power emission at the fundamental.

23313 **Thermal conductivity of a strongly coupled plasma.** Rinker, G.A. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 7, 4220-4229(1 Apr 1985).

This is the second in a series of papers concerning the transport properties of dense plasmas. In this work, we use the formalism of Lampe to extend our previous calculations of electrical conductivity to the calculation of thermal conductivity and thermoelectric coefficient. Quantitative results are given for iron at temperatures ranging from 10^{-3} to 10^{4} eV and for densities from 3 x 10^{-4} to 10^{5} g/cm^3.

23314 **Observation and analysis of maser activity in a tokamak plasma.** Gandy, R.F.; Hutchinson, I.H.; Yates, D.H. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **54**: No. 8, 800-803(25 Feb 1985). Contract AC02-78ET51013.

High-resolution spectral measurements of electron plasma-frequency emission from alcator C tokamak reveal a level of coherence indicative of maser activity ($\Delta\omega/\omega = 6 \times 10^{-6}$). A full-wave theoretical analysis yields the complete mode structure of the electromagnetic fields as well as the dispersion relation. This analysis shows that for wave frequencies near the central plasma frequency the waves are highly localized and thereby the plasma forms a high-Q cavity for these waves.

23315 **Polarimetric measurement of plasma poloidal magnetic field via heterodyne phase shift methods.** Erickson, R.M.; Forman, P.R.; Jahoda, F.C.; Roberts, J.R. (Los Alamos National Laboratory, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 4, 275-280(Dec 1984).

The rotation of the plane of polarization of radiation propagating through a magnetized plasma (Faraday effect) yields the line integral of the electron density times the longitudinal magnetic field component. A commonly used technique for this measurement senses the change in intensity of a laser beam after passing through a linear polarizer. Two methods often employed to facilitate detection are 1) to mix the transmitted beam with a frequency-offset reference beam to allow heterodyne detection and 2) to oscillate the polarization direction of the laser beam. In addition to being sensitive to spurious amplitude variations, such amplitude measurements are sensitive to small polarization ellipticities introduced by optical components as well as by transverse magnetic fields within the plasma. By the addition of a quarter wave plate, the Faraday rotation can alternatively be sensed as a phase shift of the heterodyne beat of two frequency-offset input beams relative to the case of no plasma. This scheme has the advantage of phase modulation over amplitude modulation, i.e., independence of absolute amplitude and weak dependence on amplitude change. We demonstrate with Jones matrix algebra how the measured phase shift depends only weakly on imperfections and angular alignments of the optical components. Moreover, the phase shifts can be increased more than an order of magnitude by deliberate modifications in the basic optical configuration at a sacrifice of comparable amounts of the amplitude modulation of the carrier from which the phase shift is determined. This enhancement has been experimentally verified on the ZT-40M reversed field plasma device.

23316 **Stabilizing windings for tilting and shifting modes.** Jardin, S.C.; Christensen, U.R. (to Dept. of Energy). US Patent 4,476,085. 9 Oct 1984. Filed date 26 Feb 1982. vp. PAT-APPL-352745.

This invention relates to passive conducting loops for stabilizing a plasma ring against unstable tilting and/or shifting modes. To this end, for example, plasma ring in a spheromak is stabilized by a set of four figure-8 shaped loops having one pair on one side of the plasma and one pair on the other side with each pair comprising two loops whose axes are transverse to each other.

23317 **Theoretical study of generalized toroidal cusp configurations.** Leboeuf, J.N. (Texas Univ., Austin (USA). Inst. for Fusion Studies); Ratliff, S.T. (Lockheed-California Co., Burbank (USA)); Dawson, J.M. (California Univ., Los Angeles (USA). Dept. of Physics). *Nuclear Fusion;* **24**: No. 10, 1269-1276(Oct 1984).

Hot electrons as well as hot ions are a desirable feature of any fusion device. By particle simulations (in slab geometry) and simple theory, investigations are made on two variants of the Toroidal Cusp Experiment (TCX) with an eye to achieving hot electrons, while retaining its large direct ion heating feature. A toroidal field added to the TCX configuration, with cusp magnets arranged poloidally to partly cancel cusp trapping of the electrons, ensures electron flow across the cusps and electron heating. Helical winding of the cusp magnets around the torus with pitch theta > or approx.(m/M)sup(1/2) allows trapped electron flow on average helical paths; however, ions can still flow across the cusps, and the J-vector.E-vector heating of ions and electrons can be varied at will.

23318 **Thermal energy confinement scaling in PDX limiter discharges.** Kaye, S.M.; Goldston, R.J.; Bell, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **24**: No. 10, 1303-1334(Oct 1984).

Experiments were performed on the PDX tokamak to study plasma heating and beta scaling with high-power, near-perpendicular neutral-beam injection. The data taken during these experiments were analysed, using a time-dependent data interpretation code (TRANSP), to study the transport and thermal confinement scaling over a wide range of plasma parameters. This study focuses on results from experiments with Dsup(0) injection into H^+ plasmas

using graphite rail limiters, a=40-44 cm, R=143 cm, Isub(p)=200-480 kA, Bsub(T)=0.7-2.2 T, and, typically, n-barsub(e)=(2.5-4.2)x$10^{13}$$cm^{-3}$. The results of this study indicate that for both Ohmic and neutral-beam-heated discharges the energy flow out of the plasma is dominated by anomalous electron losses which are attributed to electron thermal conduction. The ion conduction losses are not inconsistent with neoclassical theory; however, the total ion loss influences the power balance significantly only at high toroidal fields and high plasma currents. Therefore, except for these cases, the total thermal energy confinement time for the neutral-beam-heated discharges follows the scaling of electron energy confinement. While the confinement is found to have little dependence on toroidal field, it is a strong function of plasma current, increasing with increasing Isub(p). In contrast, Ohmic confinement times are found to scale as n-barsub(e)qsup(1/2). Because of the dominant effect of the electrons, the total confinement is found to depend heavily on the variation of the electron thermal diffusivity, chisub(e), in the outer region of the plasma (a/2<=r<=7a/8). The values of chisub(e) in this region of the plasma show an approximately inverse dependence on the local value of the poloidal magnetic field.

23319 **Kinetic analysis of nuclear and Coulomb scattering in high-temperature tandem mirror plasmas.** Kantrowitz, F.D.; Conn, R.W. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). *Nuclear Fusion;* **24**: No. 10, 1335-1346(Oct 1984).

A two-dimensional kinetic theory analysis is used to determine distribution functions in high-temperature mirror plasmas in which both Coulomb and nuclear elastic scattering are important. The discrete nature of nuclear scattering and the continuous nature of Coulomb scattering are incorporated. The distribution functions are used to obtain the energy deposition and energy and particle loss rates for fusion reaction products such as alpha particles and protons in the central-cell plasma of a tandem mirror. The confinement time for neutral-beam-injected ions in the plug of a tandem mirror or in a single-cell mirror is also determined. Large-angle scattering losses are found to depend more strongly on mirror ratio than losses due to small-angle scattering, although including the motion of background ions reduces the effects of nuclear scattering. For d-t reactor parameters, the effects of nuclear scattering are not significant. For d-d reactors, however, the confinement time for 700 keV plug neutral beams is found to decrease by 20%.

23320 **Plasma transport caused by ion/neutral atom collisions. I. Slab model.** Auerbach, S.P.; Cohen, R.H.; Gilmore, J.M.; Mirin, A.A.; Rensink, M.E. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Fusion;* **24**: No. 10, 1251-1267(Oct 1984).

The transport of plasma across a magnetic field, induced by ion/neutral atom collisions, is studied. Both charge exchange and electron-impact ionization are shown to cause such transport. A kinetic theory calculation of cross-field particle and energy fluxes is given, for slab geometry. A self-consistent numerical simulation of the effect of these fluxes in the TMX experiment is presented. Good agreement with experiment is found.

23321 **Model for coupled plasma current and position feedback control in the ISX-B tokamak.** Neilson, G.H.; Dyer, G.R.; Edmonds, P.H. (Oak Ridge National Lab., TN (USA)). *Nuclear Fusion;* **24**: No. 10, 1291-1302(Oct 1984).

In the ISX-B tokamak, the poloidal fields are supplied by sets of coils which are functionally coupled, in the sense that each set contributes to both the Ohmic-heating (OH) flux and the vertical field (VF), in contrast to the traditional way of grouping coils into 'decoupled' OH and VF windings. As a result, control of the plasma current Isub(p) and control of the horizontal position Δsub(R) are also strongly coupled. A transfer matrix model of this system is described, and the model is used to guide both the design and analysis of Isub(p) and Δsub(R) feedback control for ISX-B. The equations are linearized about a plasma equilibrium operating point to facilitate the analysis of stability and noise sensitivity. On slow time scales, the non-linearities are tractable enough to be used in large-signal analysis as well. The model accurately simulates actual ISX-B behaviour and can be generalized to any tokamak, since Isub(p)-Δsub(R) coupling in fact always exists. It is especially applicable to future large machines, such as the TFCX and INTOR, which of engineering necessity will have functionally coupled windings.

23322 **Zero-current high-beta stellarator equilibria with rotational transform profile control.** Carreras, B.A.; Hicks, H.R.; Holmes, J.A.; Lynch, V.E.; Neilson, G.H. (Oak Ridge National Lab., TN (USA)). *Nuclear Fusion;* **24**: No. 10, 1347-1355(Oct 1984).

Zero-current high-beta equilibria for a stellarator device are calculated using the averaging method. It is found that, by shaping the vertical field, the rotational transform can be controlled in an approximate way as beta is increased. At the same time, the Pfirsch-Schlueter currents are reduced - with no modification of the magnetic well. This permits access to the high-beta regime with more favourable rotational transform profiles. Results are presented for the Advanced Toroidal Facility (ATF) device.

23323 **MHD stability of high-beta tokamak equilibria with pedestal and line-tying.** Lee, J.K.; Chu, M.S. (GA Technologies, Inc., San Diego, CA (USA)). *Nuclear Fusion;* **24**: No. 10, 1360-1364(Oct 1984).

Letter-to-the-editor.

A high-beta circular tokamak equilibrium with a large pressure gradient near the plasma edge is examined with respect to magnetohydrodynamic stability including external kink, tearing, and ballooning modes with and without line-tying effects. As the edge pressure gradient increases, the linear growth rate decreases and the mode spectrum broadens with the perturbation increasingly localized near the edge.

23324 **(ORNL-tr—5197) Theory of the magnetic field and plasma rotation in a stellarator.** Coronado-Gallardo, M. (Oak Ridge National Lab., TN (USA); Technische Univ. Muenchen (Germany, F.R.)). 1984. Contract AC05-84OR21400. Translation source information not available . 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85007853.

The following topics are discussed: (1) the continuity equation, (2) impulse balance equation, (3) plasma velocity, (4) diffusion fluxes, (5) viscosity and impact term, (6) determination of parallel velocity, (7) the ambipolar electric field, (8) calculation of diffusion fluxes and currents, and (9) application to stellarator Wendelsein VII-A. (MOW)

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REFER ALSO TO CITATION(S) 70020022878, 23315

23325 **(ANL/FPP/TM—197) SPECTER: neutron damage calculations for materials irradiations.** Greenwood, L.R.; Smither, R.K. (Argonne National Lab., IL (USA)). Jan 1985. Contract W-31-109-ENG-38. 65p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85005791.

Neutron displacement damage-energy cross sections have been calculated for 41 isotopes in the energy range from 10^{-10} to 20 MeV. Calculations were performed on a 100-point energy grid using nuclear cross sections from ENDF/B-V and the DISCS computer code. Elastic scattering is treated exactly including angular distributions from ENDF/B-V. Inelastic scattering calculations consider both discrete and continuous nuclear level distributions. Multiple (n,xn) reactions use a Monte Carlo technique to derive the recoil distributions. The (n,d) and (n,t) reactions are treated as (n,p) and (n,^{3}He) as (n,^{4}He). The (n,γ) reaction and subsequent β-decay are also included, using a new treatment of γ-γ coincidences, angular correlations, β-neutrino correlations, and the incident neutron energy. The Lindhard model was used to compute the energy available for nuclear displacement at each recoil energy. The SPECTER computer code has been developed to simplify damage calculations. The user need only specify a neutron energy spectrum. SPECTER will then calculate spectral-averaged displacements, recoil spectra, gas production, and total damage energy (Kerma). The SPECTER computer code package is readily accessible to the fusion community via the National Magnetic Fusion

Energy Computer Center (NMFECC) at Lawrence Livermore National laboratory.

23326 **(ANL/FPP/TM—198) Design of the waveguide for microwave heating of solid lithium ceramic blankets.** Kustom, R.L.; Fendley, P.; Tidona, J. (Argonne National Lab., IL (USA)). Jan 1985. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009776.

A description is given of the design of a dielectric-loaded waveguide for thermohydraulic testing of solid ceramic tritium breeder material in a non-nuclear environment. The dielectric-loaded waveguide provides uniform heating over module surfaces that would face a fusion reactor plasma and simulates the exponential power decay characteristic of the neutron flux over the high power region of the blankets. A 200-MHz design suitable for modules with cross section of up to 20 x 40 cm is presented.

23327 **(CONF-850310—42) Material and electromagnetic properties of Faraday shields for ion cyclotron heating antennas.** Hoffman, D.J.; Becraft, W.R.; Baity, F.W.; Caughman, J.B.O.; Tsai, C.C. (Oak Ridge National Lab., TN (USA); General Electric Co., Schenectady, NY (USA)). 1985. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009292.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

The Faraday shields for ion cyclotron antennas must transmit magnetic waves and adsorb little rf power. To investigate these properties, we have constructed 27 Faraday shields in many configurations, including chevrons, tubes, straps, concentric rings, various layered shields, conventionally leafed straps, and replicas of the Faraday shields for ASDEX, the Joint European Torus (JET), TEXTOR, and Alcator-C. We have measured the magnetic flux and observed loading at various operating resistances by using dielectric sheets or magnetic-coupled loads. Each Faraday shield effects a net change in the characteristic inductance of the antenna, resulting in a reduction of wave coupling. However, the load experienced by the antenna is not always reduced because the Faraday shield itself acts as a load. We differentiate between these effects experimentally. The net result of the study is that the Faraday shields now in use cost up to a factor of 50% of coupling. This, of course, reduces the power handling capability by 50% as well. However, configurations exist that are easily cooled and result in a reduction of less than 5% in loading.

23328 **(CONF-850310—43) Computerized cost estimation spreadsheet and cost data base for fusion devices.** Hamilton, W.R.; Rothe, K.E. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009323.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Component design parameters (weight, surface area, etc.) and cost factors are input and direct and indirect costs are calculated. The cost data base file derived from actual cost experience within the fusion community and refined to be compatible with the spreadsheet costing approach is a catalog of cost coefficients, algorithms, and component costs arranged into data modules corresponding to specific components and/or subsystems. Each data module contains engineering, equipment, and installation labor cost data for different configurations and types of the specific component or subsystem. This paper describes the assumptions, definitions, methodology, and architecture incorporated in the development of the cost estimation spreadsheet and cost data base, along with the type of input required and the output format.

23329 **(DOE/DP/40190—1) Simulated laser plasma interaction. Final report.** Dawson, J.M. (California Univ., Los Angeles (USA). Dept. of Physics). 1983. Contract AS08-83DP40190. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008335.

The generation of hot electrons by fast large-amplitude plasma waves resulting from intense lasers is both a serious preheat problem in laser fusion and the basis for the recently proposed laser plasma accelerator schemes. During the past year we have investigated the generation of hot electrons from both single and double frequency illumination using 1-D computer simulations.

23330 **(DOE/ER—0046/20) Damage analysis and fundamental studies. Quarterly progress report, October-December 1984.** (USDOE Office of Energy Research, Washington, DC. Office of Fusion Energy). Feb 1985. Contract AC06-76FF02170. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009869.

Separate abstracts were prepared for each section. (MOW)

23331 (DOE/ER/10275—1B, pp 71) **Implementation and use of the SWAN package at TAMU.** Schuller, M. (Texas A and M Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23332 (DOE/ER/10275—1B, pp 73) **Missouri Research and Educational Mirror Fusion Facility.** Wallace, C. (Univ. of Missouri, Columbia). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23333 (DOE/ER/10275—1B, pp 74) **Thorium oxide slurries for use in catalyzed-deuterium fusion hybrids.** Geer, T.C. (Texas A and M Univ., College Station). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23334 (DOE/ER/10275—1B, pp 75) **System aspects of electricity consuming fissile fuel factories.** Doyle, J.C. Jr. (Massachusetts Inst. of Tech., Cambridge). 1982. NTIS, PC A04/MF A01. File Number DE83004081. (CONF-820494—Absts.).

From American Nuclear Society regional student conference; Columbia, MO, USA (1 Apr 1982).

23335 **(DOE/ER/52092—T1) Research on megawatt gyrotrons, January 1983-December 1984.** Read, M.E. (Naval Research Lab., Washington, DC (USA). Plasma Physics Div.). 18 Dec 1984. Contract AI05-83ER52092. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009962.

During the last several years, NRL has performed research on concepts for high power gyrotrons. The work funded by the Department of Energy has been in support of industrial development of high frequency (60 to 140 GHz) CW gyrotrons, with NRL research being on the origination, development, and testing of advanced concepts. The research performed under this agreement has included experimental work on quasi-optical and complex cavity gyrotrons and theoretical efforts on these concepts as well as whispering gallery gyrotrons.

23336 **(DOE/ER/53179—T2) Nuclear spin-polarized HD, D_2, HT and DT solids, liquids and high density gases. Quarterly status report No. 4, December 1, 1984-February 28, 1985.** (Syracuse Univ., NY (USA). Dept. of Physics). 28 Mar 1985. Contract FG02-84ER53179. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009019.

During this past quarter, we have succeeded in reproducibly making ortho-D_2 in the heretofore unattained purity range 0.997 to 0.999 by direct heterogeneous catalytic conversion.

23337 (EGG-PBS—6808) TFTR lithium blanket module program. Final design report. Volume VII. LBM instrumentation and Program of Experiments and Analysis. Harker, Y.D.; Tsang, F.Y.; Jassby, D.L. (eds.). (EG and G Idaho, Inc., Idaho Falls (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1983. Contract AC07-76ID01570. 255p. (EPRI-RP—1748). NTIS, PC A12/MF A01; GPO Dep. File Number DE85009927.

The Program of Experiments and Analysis comprises 3 spheres of activity: (1) measurements of neutron fluence and flux spectra inside and around the LBM, and of tritium production in the LBM central zone; (2) neutronic-code modeling and analysis of the TFTR/LBM system to predict the quantities measured in (1); (3) comparisons of the predicted and measured quantities, and improvements of the code modeling and analysis and the experimental techniques, in order to resolve any discrepancy between prediction and measurement. The measurement techniques are discussed. Section 5 of this volume discusses the strategy for carrying out the measurement program, for making comparisons with the neutronics code predictions, and for resolving discrepancies.

23338 (EPRI-AP—3853-Vol.2) Light ion system analysis and design. Volume 2: Phase II - Engineering Test Reactor development plan. Allen, W. (Bechtel Group, Inc., San Francisco, CA (USA)). Mar 1985. 93p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920575.

A near-term technology development plan leading to the commercialization of light ion fusion is described. The goal of the plan is to provide the technical understanding required to construct an Engineering Test Reactor (ETR). The ETR would be the first commercially-oriented light ion fusion facility to demonstrate the integrated performance of a light ion beam generator, a fusion target, and a reaction chamber. A conceptual design for the ETR is described, and the technology required for its implementation is identified. The technology issues are ranked by risk and priority, and programs are proposed to resolve the most important ones. New experimental facilities are identified to support the recommended resolution programs. It is concluded that a major new high-voltage, high-power ion beam generator facility is required to demonstrate the repetitive operation of the pulsed power, diode, and beam transport systems prior to the ETR. Near-term proof of principal experiments are found to be required for the diode and the high-voltage pulsed power system.

23339 (HEDL-SA—3181-FP-Draft) Development of reduced activation alloys for fusion service. Draft. Brager, H.R.; Garner, F.A.; Gelles, D.S.; Hamilton, M.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1984. Contract AC06-76FF02170. 13p. (CONF-841246—20-Draft). NTIS, PC A02/MF A01; GPO Dep. File Number DE85007464.

From 1. international conference on fusion reactor materials; Tokyo, Japan (3 Dec 1984).

The development of low activation alloys is one of the goals of the materials program of the US Magnetic Fusion Energy Program. Irradiation of two series of such alloys has commenced in FFTF. One series is based on austenitic steels with manganese substituting for nickel, and the other is based on ferritic steels with vanadium and/or tungsten substituting for molybdenum and niobium. In addition to the irradiation experiments, parallel studies on corrosion resistance in flowing lithium, preirradiation ductility and thermal stability are also in progress. This paper reviews the results of irradiation at 420, 500 and 600°C to 15 dpa and also describes the early results of the ex-reactor studies.

23340 (LA-UR—85-752) Comparison study of toroidal-field divertors for a compact reversed-field pinch reactor. Bathke, C.G.; Krakowski, R.A.; Miller, R.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850310—44). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009591.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Two divertor configurations for the Compact Reversed-Field Pinch Reactor (CRFPR) based on diverting the minority (toroidal) field have been reported. A critical factor in evaluating the performance of both poloidally symmetric and bundle divertor configurations is the accurate determination of the divertor connection length and the monitoring of magnetic islands introduced by the divertors, the latter being a three-dimensional effect. To this end the poloidal-field, toroidal-field, and divertor coils and the plasma currents are simulated in three dimensions for field-line tracings in both the divertor channel and the plasma-edge regions. The results of this analysis indicate a clear preference for the poloidally symmetric toroidal-field divertor. Design modifications to the limiter-based CRFPR design that accommodate this divertor are presented.

23341 (LA-UR—85-753) Recent progress in stellarator reactor conceptual design. Miller, R.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 10p. (CONF-850310—45). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009592.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

The Stellarator/Torsatron/Heliotron (S/T/H) class of toroidal magnetic fusion reactor designs continues to offer a distinct and in several ways superior approach to eventual commercial competitiveness. Although no major, integrated conceptual reactor design activity is presently underway, a number of international research efforts suggest avenues for the substantial improvement of the S/T/H reactor embodiment, which derive from recent experimental and theoretical progress and are responsive to current trends in fusion-reactor projection to set the stage for a third generation of designs. Recent S/T/H reactor design activity is reviewed and the impact of the changing technical and programmatic context on the direction of future S/T/H reactor design studies is outlined.

23342 (LA-UR—85-962) New tritium monitor for the Tokamak Fusion Test Reactor. Jalbert, R.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850405—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009568.

From 2. national topical meeting on tritium technology in fission, fusion and isotopic applications; Dayton, OH, USA (30 Apr 1985).

At DT-fueled fusion reactors, there will be a need for tritium monitors that can simultaneously measure in real time the concentrations of HTO, HT and the activated air produced by fusion neutrons. Such a monitor has been developed, tested and delivered to the Princeton Plasma Physics Laboratory for use at the Tokamak Fusion Test Reactor (TFTR). It uses semipermeable membranes to achieve the removal of HTO from the sampled air for monitoring and a catalyst to convert the HT to HTO, also for removal and monitoring. The remaining air, devoid of tritium, is routed to a third detector for monitoring the activated air. The sensitivities are those that would be expected from tritium instruments employing conventional flow-through ionization chambers: 1 to 3 $\mu Ci/m^3$. Its discriminating ability is approximately 10^{-3} for any of the three components (HTO, HT and activated air) in any of the other two channels. For instance, the concentration of HT in the HTO channel is 10^{-3} times its original concentration in the sampled air. This will meet the needs of TFTR.

23343 (LA-UR—85-983) Experiments on a ceramic electrolysis cell and a palladium diffuser at the tritium systems test assembly. Konishi, Satoshi; Yoshida, Hiroshi; Ohno, Hideo; Naruse, Yuji; Coffin, D.O.; Walthers, C.R.; Binning, K.E. (Japan Atomic Energy Research Inst., Tokai, Ibaraki; Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 16p. (CONF-850405—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009636.

From 2. national topical meeting on tritium technology in fission, fusion and isotopic applications; Dayton, OH, USA (30 Apr 1985).

A ceramic electrolysis cell and a palladium diffuser are developed in Japan and is tested with tritium in Tritium Systems Test Assembly (TSTA) of the Los Alamos National Laboratory, in order to confirm the feasibility as possible upgrades for the fuel cleanup system (PCU). The ceramic electrolysis cell made of stabilized zirconia was operated at 630°C for an extended period with a mixture of 3% T_2O in He carrier gas in the circulation system with

oxidizing catalyst bed. The palladium diffuser was tested with circulated pure tritium gas at 280°C to verify the compatibility of the alloy with tritium, since the ^{3}He produced in the metal could cause a degradation. The isotopic effects were also measured for both devices.

23344 (NRL-Memo—5515) Current distribution in a plasma erosion opening switch. Weber, B.V.; Commisso, R.J.; Meger, R.A.; Neri, J.M.; Oliphant, W.F.; Ottinger, P.F. (Naval Research Lab., Washington, DC (USA)). 27 Feb 1985. Contract AI08-79DP40092. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008244.

The current distribution in a plasma erosion opening switch is determined from magnetic field probe data. During the closed state of the switch the current channel broadens rapidly. The width of the current channel is consistent with a bipolar current density limit imposed by the ion flux to the cathode. The effective resistivity of the current channel is anomalously large. Current is diverted to the load when a gap opens near the cathode side of the switch. The observed gap opening can be explained by erosion of the plasma. Magnetic pressure is insufficient to open the gap.

23345 (ORNL/FEDC—83/9) MFTF-α + T progress report. Nelson, W.D. (ed.). (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 589p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE85010208.

Early in FY 1983, several upgrades of the Mirror Fusion Test Facility (MFTF-B) at Lawrence Livermore National Laboratory (LLNL) were proposed to the fusion community. The one most favorably received was designated MFTF-α+T. The engineering design of this device, guided by LLNL, has been a principal activity of the Fusion Engineering Design Center during FY 1983. This interim progress report represents a snapshot of the device design, which was begun in FY 1983 and will continue for several years. The report is organized as a complete design description. Because it is an interim report, some parts are incomplete; they will be supplied as the design study proceeds. As described in this report, MFTF-α+T uses existing facilities, many MFTF-B components, and a number of innovations to improve on the physics parameters of MFTF-B. It burns deuterium-tritium and has a central-cell Q of 2, a wall loading Γ/sub n/ of 2 MW/m^2 (with a central-cell insert module), and an availability of 10%. The machine is fully shielded, allows hands-on maintenance of components outside the vacuum vessel 24 h after shutdown, and has provisions for repair of all operating components.

23346 (ORNL/FEDC—84/10) Availability program: Phase I report. Thomson, S.L.; Dabiri, A.; Keeton, D.C.; Riemer, B.W.; Waganer, L.M. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010451.

An Availability Working Group was formed within the Office of Fusion Energy in March 1984 to consider the establishment of an availability program for magnetic fusion. The scope of this program is defined to include the development of (1) a comprehensive data base, (2) empirical correlations, and (3) analytical methods for application to fusion facilities and devices. The long-term goal of the availability program is to develop a validated, integrated methodology that will provide (1) projections of plant availability and (2) input to design decisions on maintainability and system reliability requirements. The Phase I study group was commissioned to assess the status of work in progress that is relevant to the availability program. The scope of Phase I included surveys of existing data and data collection programs at operating fusion research facilities, the assessment of existing computer models to calculate system availability, and the review of methods to predict and correlate data on component failure and maintenance. The results of these investigations are reported to the Availability Working Group in this document.

23347 (ORNL/TM—9504) Flexible heliac configuration. Harris, J.H.; Cantrell, J.L.; Hender, T.C.; Carreras, B.A.; Morris, R.N. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009671.

The addition of an l = 1 helical winding to the heliac central conductor adds a significant degree of flexibility to the configuration by making it possible to control the rotational transform and shear. Such control is essential for an experiment because the presence of low-order resonances in the rotational transform profile can cause breakup of the equilibrium magnetic surfaces. The use of the additional winding also permits reduction of the total central conductor current and can deepen the magnetic well.

23348 (SAI—168-201-016) Analysis of the potential of the Tm^{2+}:YLF:XeF laser system as a fusion driver. Manzo, P.R.; Schlecht, R.; Verdun, H.R. (Science Applications International Corp., McLean, VA (USA)). Feb 1981. Contract AC01-78DP40057. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008167.

The element thulium (Tm) in the yttrium lithium floride lattice (YLF) has an absorption band which corresponds to the output wavelength of the Xenon floride (XeF) laser. Its fluorescence is centered around 451 nm and lasing has been demonstrated at this wavelength. The decays which take place within the energy level structure appear to be primarily radiative so that there is potentially low heat loading in this solid. In addition since it is a crystal the heat conduction properties of YLF are quite good. At first glance this appears to be a very interesting system for fusion applications. This study will examine this particular RGH/SS system further to determine its suitability for fusion applications.

23349 (UCID—20154) Feasibility study of a fission-suppressed tokamak fusion breeder. Moir, R.W.; Lee, J.D.; Neef, W.S.; Berwald, D.H.; Garner, J.K.; Whitley, R.H.; Ghoniem, N.; Wong, C.P.C.; Maya, I.; Schultz, K.R. (Lawrence Livermore National Lab., CA (USA)). Dec 1984. Contract W-7405-ENG-48. 232p. NTIS, PC A11/MF A01; GPO Dep. File Number DE85009099.

The preliminary conceptual design of a tokamak fissile fuel producer is described. The blanket technology is based on the fission suppressed breeding concept where neutron multiplication occurs in a bed of 2 cm diameter beryllium pebbles which are cooled by helium at 50 atmospheres pressure. Uranium-233 is bred in thorium metal fuel elements which are in the form of snap rings attached to each beryllium pebble. Tritium is bred in lithium bearing material contained in tubes immersed in the pebble bed and is recovered by a purge flow of helium. The neutron wall load is 3 MW/m^2 and the blanket material is ferritic steel. The net fissile breeding ratio is 0.54 +- 30% per fusion reaction. This results in the production of 4900 kg of ^{233}U per year from 3000 MW of fusion power. This quantity of fuel will provide makeup fuel for about 12 LWRs of equal thermal power or about 18 1 GW/sub e/ LWRs. The calculated cost of the produced uranium-233 is between $23/g and $53/g or equivalent to $10/kg to $90/kg of U_3O_8 depending on government financing or utility financing assumptions. Additional topics discussed in the report include the tokamak operating mode (both steady state and long pulse considered), the design and breeding implications of using a poloidal divertor for impurity control, reactor safety, the choice of a tritium breeder, and fuel management.

23350 (UCID—20340) Titanium-getter testing for TMX-U. Clower, C.A. Jr. (Lawrence Livermore National Lab., CA (USA)). 7 Mar 1985. Contract W-7405-ENG-48. 22p. NTIS, PC A02MF A01; 1; GPO Dep. File Number DE85008877.

This report summarizes the results of titanium-gettering tests performed during August and September of 1983. Several current and voltage schedules were evaluated for possible implementation with TMX-U's computer-controlled getter system. The tests were performed using 1/8-inch wire composed of 85% Ti and 15% Ta. Measurements of wire temperature as a function of getter current were made. We performed glow discharge cleaning (GDC) of the vessel with wires in place to determine if GDC had any adverse effect on wire lifetime.

23351 **Thermal transport measurements in six-beam, ultraviolet irradiation of spherical targets.** Yaakobi, B.; Barnouin, O.; Delettrez, J.; Goldman, L.M.; Marjoribanks, R.; McCrory, R.L.; Richardson, M.C.; Soures, J.M. (Laboratory for Laser Energetics, 250 East River Road, University of Rochester, Rochester, New York 14623). *Journal of Applied Physics;* **57**: No. 9, 4354-4359(1 May 1985). Contract AC08-80DP40124.

Thermal transport, mass ablation rates, and preheat have been studied in spherical irradiation at $\lambda = 351$ nm, using six of the 24 beams of the OMEGA spherical irradiation laser system at the Laboratory for Laser Energetics. Mass ablation rates are higher at 351-nm than at 1054-nm irradiation, even when compared at the same absorbed irradiance. Similar to the case of 1054-nm irradiation, very deep burnthrough was found at 351 nm. However, the shallow-gradient temperature profile at the heat front, characteristic of the experiments at 1054 nm, was not observed here, nor was the large difference between uniform and tight focus irradiation of spherical targets. Ablation pressures derived from charge-collector data rise from 10 to 100 Mbar for absorbed irradiance in the range of 4×10^{13} to 9×10^{14} W/cm^2.

23352 **Planar laser-driven ablation: Effect of inhibited electron thermal conduction.** Fabbro, R.; Max, C.; Fabre, E. (GRECO Interaction Laser-Matiere, Ecole Polytechnique, 91128 Palaiseau, France). *Physics of Fluids;* **28**: No. 5, 1463-1481(May 1985). Contract W-7405-ENG-48.

A model for planar laser-driven ablation is presented, including the effects of inhibited electron thermal conduction. Localized deposition of laser energy at the critical-density surface is assumed. A steady-state solution in the conduction zone is joined to a rarefaction wave in the underdense corona. The global flow structure is calculated, as well as the ablation pressure, ablation rate, and hydrodynamic efficiency. Criteria are developed for the importance of the inertial force caused by the acceleration of the slab. The results agree well with time-dependent computer simulations using a Lagrangian hydrodynamics code.

23353 **Tandem mirror coil optimization studies.** Francis, G.L.; D'Ippolito, D.A.; Myra, J.R. (Science Applications, International Corporation, Plasma Research Institute, Boulder, CO 80302). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 4, 237-245(Dec 1984).

A recently developed numerical algorithm for optimizing quadrupole magnetic coil systems is applied to the tandem mirror design problem. By adjusting filamentary coil shapes, the magnetic field structure minimizing radial particle transport is found, subject to a stability constraint. Two configurations are examined: a MARS-like reactor design and an unconventional TMX-like system with a nonaxisymmetric central cell. In the later case, a number of nearly omnigenous geometries with various stability properties are investigated.

23354 **Multishell inertial confinement fusion target.** Holland, J.R.; Del Vecchio, R.M. (to Dept. of Energy). US Patent 4,477,958. 23 Oct 1984. Filed date 1 Jun 1981. vp.

PAT-APPL-269286.

A method of fabricating multishell fuel targets for inertial confinement fusion usage. Sacrificial hemispherical molds encapsulate a concentric fuel pellet which is positioned by fiber nets stretched tautly across each hemispherical mold section. The fiber ends of the net protrude outwardly beyond the mold surfaces. The joint between the sacrificial hemispheres is smoothed. A ceramic or glass cover is then deposited about the finished mold surfaces to produce an inner spherical surface having continuously smooth surface configuration. The sacrificial mold is removed by gaseous reaction accomplished through the porous ceramic cover prior to enclosing of the outer sphere by addition of an outer coating. The multishell target comprises the inner fuel pellet concentrically arranged within a surrounding coated cover or shell by fiber nets imbedded within the cover material.

23355 **Plasma-surface interactions in controlled fusion devices. Report on the 6. International Conference on Plasma-Surface Interactions in Controlled Fusion Devices, Nagoya, Japan, 14-18 May 1984, and the workshop on Synergistic Effects in Surface Phenomena, Related to Plasma-Wall Interactions, Nagoya, Japan, 21-23 May 1984.** Bauer, W. (Sandia National Labs., Livermore, CA (USA)); Roberto, J.B. (Oak Ridge National Lab., TN (USA)). *Nuclear Fusion;* **24**: No. 10, 1367-1370(Oct 1984).

The report gives a brief synopsis of the Sixth International Conference on Plasma-Surface Interactions in Controlled Fusion Devices held in Nagoya, May 1984, followed by a workshop on Synergistic Effects in Surface Phenomena, Related to Plasma-Wall Interactions. The first part is an enumeration of the main papers presented in connection with the understanding and control of plasma-surface interactions at the first wall and other plasma interactive components. The subjects (presented in cca. 185 papers) included: large fusion devices, divertor tokamaks, non-tokamak devices, plasma edge modelling, boundary plasmas, limiters, diagnostics, wall conditioning, erosion and hydrogen recycling. The second part continues with the workshop on the synergistic effects. A consistent definition of synergism is specified and the discussions on synergistic effects observed in fusion devices are presented. These include synergisms in hydrogen recycling and erosion.

23356 **Cermet coatings for magnetic fusion reactors.** Smith, M.F.; Whitley, J.B.; McDonald, J.M. (Sandia National Labs., Albuquerque, NM (USA)). *Thin Solid Films;* **118**: No. 1, 23-29(3 Aug 1984). (CONF-8404135—).

From International conference on metallurgical coatings; San Diego, CA, USA (9 Apr 1984).

Cermet coatings consisting of SiC particles in an aluminum matrix were produced by a low pressure chamber plasma spray process. Properties of these coatings are being investigated to evaluate their suitability for use in the next generation of magnetic confinement fusion reactors. Although this preliminary study has focused primarily upon SiC-Al cermets, the deposition process can be adapted to other ceramic-metal combinations. Potential applications for cermet coatings in magnetic fusion devices are presented along with experimental results from thermal tests of candidate coatings.

99 GENERAL AND MISCELLANEOUS

23357 **(ANL—85-9) Chemical Technology Division annual technical report 1984.** (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 202p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85009794.

In this period, CMT conducted research and development in the following areas: (1) advanced batteries - mainly lithium alloy/metal sulfide and sodium/sulfur for electric vehicles; (2) aqueous batteries - mainly improved lead-acid and nickel/iron for electric vehicles; (3) advanced fuel cells with molten carbonate or solid oxide electrolytes; (4) coal utilization, including the heat and seed recovery technology for coal-fired magnetohydrodynamic plants and the technology for pressurized fluidized-bed combustors; (5) methodologies for recovery of energy from municipal waste; (6) solid and liquid desiccants that allow moisture to be removed with a minium of energy; (7) nuclear technology related to waste management, proof of breeding for a light water reactor, and the recovery processes for discharged fuel and the uranium blanket in a sodium-cooled fast reactor; and (8) physical chemistry of selected materials in environments simulating those of fission, fusion, and other energy systems. The Division also has a program in basic chemistry research in the areas of fluid catalysis for converting abundant raw materials to desired products; materials chemistry of liquids and vapors at high temperatures; interfacial processes of importance to corrosion science, surface science, and catalysis; atmospheric chemistry, most notably SO_2 oxidation mechanisms; and the thermochemistry of zeolites, related silicates, and inorganic compounds.

23358 (ANL/EES-TM—274) Transportation during periods of mobilization: a historical review. Final report. Middendorf, D.P.; Johnson, L.R. (Argonne National Lab., IL (USA)). Jul 1984. Contract W-31-109-ENG-38. 99p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009656.

The effects of the US transportation system of military preparations for war are compounded by the concurrent transportation requirements of economic mobilization to support a war effort. Several studies of military logistics have concluded that the transportation system may be the limiting factor in determining whether there is a successful operation. The responsiveness of the US transportation system during recent military conflicts is reviewed, beginning with the Spanish-American War and continuing through the Korean War. The nature and scope of each war is characterized, and the associated mobilization is described. Technological developments and regulatory changes in the transportation system since World War II are also reviewed in terms of their implications for the response capability of the nation. The dominant theme that emerges from this study is the overriding need for close coordination between modes and appropriate setting of priorities for shipments. The lack of an efficient system ultimately results in severe congestion at ports and terminals. The critical importance of the merchant marine fleet in overseas conflicts during the previous wars is also identified.

23359 (DOE/IG—0217) Review of abuse of long distance telephone service (FTS) in the Department of Energy. (USDOE Office of Inspector General, Washington, DC). 22 Mar 1985. 43p. TIC. File Number TI85008483.

It is concluded that the Department paid out over $16 million in the past two years for FTS service charges on telephone calls bearing no relationship to official Departmental business. When one adds in the costs of compensation paid to Departmental and contractor employees for the worktime spent making unauthorized FTS calls, the total costs to the Department due to FTS abuse exceeded $28 million for the fiscal years 1983 and 1984. These cost figures, moreover, fail to account for the effect of an annual loss of an estimated 40,000 man-days on the Department's productivity. It is recommended that the Assistant Secretary review the system to identify possible restrictions on usage of the lines by employees and to consider additional recording and accounting procedures to track FTS usage, especially when the lines are used for calls to telephones outside the FTS network.

23360 (DOE/MA—0138/4) Listing of awardee names: retired awards as of March 28, 1985. (USDOE Assistant Secretary for Management and Administration, Washington, DC. Procurement and Assistance Management Directorate). 1985. 624p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85009983.

This document is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy.

23361 (DOE/MA—0139/4) Listing of awardee names. Active and inactive awards as of March 28, 1985. (USDOE Assistant Secretary for Management and Administration, Washington, DC. Procurement and Assistance Management Directorate). 1985. 347p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85009947.

This document is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy.

23362 (DOE/R3/08097—T1) [Design of ceramic firebox with unipolar fan motor]. Final report. Painter, C.F. (Southwest Virginia Community Coll., Richlands (USA)). 18 Oct 1982. Contract FG43-81R308097. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009380.

Progress made on the fabrication of the ceramic firebox is described. It would include a series of nickel-copper junctions. A unipolar motor is under development. (DLC)

9901 Management

REFER ALSO TO CITATION(S) 99010023357, 23361

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 99020023224

23363 (ANL/MCS-TM—45) Extrapolation methods for multi-dimensional quadrature of singular and regular integrand functions. Lyness, J.N. (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009665.

The principal purpose of this article is to draw the readers' attention to the existence of various expansions on which extrapolation may be based. Relatively few expansions in quadrature are known. These are usually simple to state and simple to use, but some require long involved proofs (which are not given here). We also discuss a simple way to use them. A secondary purpose is to indicate how some of the elementary theory of numerical quadrature can be used on the Euler Maclaurin summation formula. If this is done, extrapolation in quadrature can be seen as a natural integrated branch of numerical quadrature and not (as is to often the case in textbooks) as an apparently independent theory. The development of an extrapolation technique is conveniently considered in three phases. The first phase involves choosing a suitable expansion on which to base the extrapolation. The second consists of deciding on a quadrature rule and a mesh ratio sequence. A third phase involves choosing an efficient algorithm for the extrapolation calculation.

23364 (ANL/MCS-TM—48) Distribution of mathematical software via electronic mail. Dongarra, J.J.; Grosse, E. (Argonne National Lab., IL (USA)). Mar 1985. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009664.

A large collection of mathematical software is now available via electronic mail. Messages sent to netlib at anl-mcs (on the Arpanet/CSNET) or to research netlib (on the UNIX network) wake up a server that distributes items from the collection. For example the on-line message, send index, gets a library catalog by return mail. We describe how to use the service and some of the issues in its implementation.

23365 (CONF-8503117—1) Tradeoffs among portability, complexity, and efficiency in multiprocessing environments. Lusk, E.L.; Overbeek, R.A. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007899.

From Workshop on parallel processing using the heterogeneous element processor; Norman, OK, USA (20 Mar 1985).

In this paper we investigate the question of reconciling portability issues with the desire to capitalize on massive parallelism. We center our attention on a fairly straightforward (but prototypical) grid computation. We describe three portable implementations suitable for use on multiprocessors: one was designed for a machine with a limited number of processors and a globally shared memory, one will function well on a machine with a large number of processors and a globally shared memory, and the last will port between a fairly wide variety of machines (including the Denelcor HEP, the CRAY-XMP, and hypercubes). Our experiences would indicate that, for those grid computations that can capitalize on massive parallelism, it is possible to write code that will port straightforwardly between machines that do support a globally shared memory and those that do not. However, such portability does introduce some complexity into the actual formulation and implementation of an appropriate algorithm.

23366 (DOE/ER/10718—1) ODIN - an extensible software environment report and user's reference manual. Clemm, G.M. (Colorado Univ., Boulder (USA). Dept. of Computer Science). Dec 1984. Contract AC02-80ER10718. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85008459.

The purpose of the Odin System is to provide an extensible program development environment. In Odin, a standard hierarchical file system is extended by the addition of user specified file types and user specified operations defined in terms of those file types. User operations are implemented through sequences of host system commands. Two languages are provided: an object oriented command language, and a specification language to allow the easy addition of new file types and operations. The user maintains in the host file system only those files that will be modified directly - the results of all operations are maintained within the Odin System.

23367 **(LA—10298-T) State space method of fault tree analysis with applications.** Bartholomew, R.J. (Los Alamos National Lab., NM (USA)). Dec 1984. Contract W-7405-ENG-36. 195p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85008910.

A widely used analytical tool for assessing safety, reliability, and risk both qualitatively and quantitatively for a broad spectrum of engineering systems is the fault tree. The fault tree is an assemblage of initiating events (the roots) that pass through an interconnected (branched) system of Boolean OR and AND gates, and ultimately lead to an undesirable TOP event. This tool has been very helpful in designing engineered safety and reliability subsystems for nuclear power plants. However, fault tree models do have some disadvantages: (1) common cause/common mode failure effects are not easily identified; and (2) temporal sequential dependencies and interdependent failure modes (intermodal coupling) cannot be depicted. The latter disadvantage can be alleviated somewhat by using an event-sequence type of analysis tool in conjunction with the fault tree. However, the former problem has required considerable clever tinkering with the minimal cut sets in a fault tree to identify and eliminate common cause/sommon mode dependencies systematically.

23368 **(LA-UR—85-16) Hands-on program of IBM-PC training at Los Alamos National Laboratory.** Lier, R.H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 21p. (CONF-850150—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005907.

From 1. regional conference on university teaching; Las Cruces, NM, USA (9 Jan 1985).

Since December 1983, the Laboratory has offered introductory courses of IBM-PC training. A comprehensive needs assessment was conducted and a nine-course module of classes was designed and implemented. Forty classes were completed in the one-year period. The target group includes the novice computer user in the scientific, management, administrative, and secretarial personnel groups. The development, needs assessment, course implementation and design, course evaluations, and future direction of computer training will be discussed. Lab-automation, robotics, design of the lab and office and the impact of computer on society will be discussed briefly.

23369 **(SAND—82-8637) Description of DASSL: a differential/algebraic system solver.** Petzold, L.R. (Sandia National Labs., Livermore, CA (USA)). Sep 1982. Contract AC04-76DR00789. 9p. (CONF-820810—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008493.

From 10. international mathematics and computers simulation congress on systems simulation and scientific computation; Montreal, Canada (9 Aug 1982).

This paper describes a new code DASSL, for the numerical solution of implicit systems of differential/algebraic equations. These equations are written in the form $F(t,y,y') = 0$, and they can include systems which are substantially more complex than standard form ODE systems $y' = f(t,y)$. Differential/algebraic equations occur in several diverse applications in the physical world. We outline the algorithms and strategies used in DASSL, and explain some of the features of the code. In addition, we outline briefly what needs to be done to solve a problem using DASSL.

23370 **(SLAC-PUB—3565) There is no I/O like no I/O.** Johnston, T.Y. (Stanford Linear Accelerator Center, CA (USA)). Jan 1985. Contract AC03-76SF00515. 8p. (CONF-850272—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009115.

From Candle Users Group meeting; Los Angeles, CA, USA (21 Feb 1985).

On most computer systems the most common cause of performance degradation is I/O contention. This paper will examine some efforts that can be taken in a VM environment to reduce I/O or its effect at both the global and local levels.

23371 **(UCRL—91882-Rev.1) Variational bounds on Darcy's constant.** Berryman, J.G. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 36p. (CONF-8410231—1-Rev.1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85008959.

From Workshop on homogenization and effective moduli of materials and media; Minneapolis, MN, USA (22 Oct 1984).

Prager's variational method of obtaining upper bounds on the fluid permeability (Darcy's constant) for slow flow through porous media is reexamined. By exploiting the freedom one has in choosing the trial stress distributions, several new results are derived. One result is a phase interchange relation for permeability; when the fluid-phase and particle-phase are interchanged for a fixed geometry, we find an upper bound on a linear combination of the complementary permeabilities. Another result is a proof of the monotone properties of the bounds. The optimal two-point bounds from this class of variational principles are evaluated numerically and compared to exact results of low density expansions for assemblages of spheres.

23372 **(UCRL—92007-Rev.1) Parallel computation of multiple-scale problems. Revision 1.** Chin, R.C.Y.; Hedstrom, G.W.; McGraw, J.R.; Howes, F.A. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA). Dept. of Mathematics). 1 Mar 1985. Contract W-7405-ENG-48. 17p. (CONF-8411140—3-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009447.

From ARO workshop on new computing environments: parellel, vector and systolic; Stanford, CA, USA (7 Nov 1984).

The efficient use of multiprocessor computers requires the introduction of new numerical algorithms, and the identification by asymptotic analysis of concurrencies inherent in the governing equations of multiple-scale problems is a good way to develop such algorithms. The language used must be able to maintain these concurrencies. Finally, depending on the problem and the computer, this concurrency may not be sufficient to keep all the processors busy, so that the language must be able to identify additional concurrencies. These ideas are illustrated in an example based on a convection-diffusion equation.

23373 **(UCRL—92211) Multigrid method for multiprocessors.** Greenbaum, A. (Lawrence Livermore National Lab., CA (USA)). 12 Feb 1985. Contract W-7405-ENG-48. 28p. (CONF-8504100—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85007929.

From 2. Copper Mountain conference on multigrid methods; Copper Mountain, CO, USA (1 Apr 1985).

A multigrid method is adapted for multiprocessor architectures by using separate processors to solve on different grids simultaneously. Convergence properties of the new method are discussed and compared with those of a standard multigrid method. Numerical results are presented on the Cray XMP-48.

23374 **(Y/DL—914) Efforts at office automation and information systems utilization at Martin Marietta Energy Systems, Inc.** Reeves, C.A. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 1 Mar 1985. Contract AC05-84OS21400. 50p. (CONF-8503118—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85008154.

From 32. PSI annual secretarial institute; Knoxville, TN, USA (6 Mar 1985).

A brief history is given of the efforts at utilization of mainframe computers, personal or desktop computers, standalone word processors, and other such devices at Martin Marietta Energy Systems in Oak Ridge, Tennessee. This discussion is concentrated on how these systems have been used in the office, both for purely technical and management oriented applications. Some detail is also given on how these systems have been used to solve some typical

problems in offices, so that others might benefit from lessons learned.

23375 Improving the accuracy of computed singular values. Dongarra, J.J. (Argonne National Lab., IL). *SIAM Journal on Scientific and Statistical Computing;* **4**: No. 4, 712-719(Dec 1983). Contract W-31-109-ENG-38.

This paper describes a computational method for improving the accuracy of a given singular value and its associated left and right singular vectors. The method is analogous to iterative improvement for the solution of linear systems. That is, by means of a low-precision computation, an iterative algorithm is applied to increase the accuracy of the singular value and vectors; extended precision computations are used in the residual calculation. The method is related to Newton's method applied to the singular value problem and inverse iteration for the eigenvalue problem.

23376 Computing a trust region step. More, J.J.; Sorensen, D.C. (Argonne National Lab., IL). *SIAM Journal on Scientific and Statistical Computing;* **4**: No. 3, 553-572(Sep 1983). Contract W-31-109-ENG-38.

An algorithm is proposed for the problem of minimizing a quadratic function subject to an ellipsoidal constraint and it is shown that this algorithm is guaranteed to produce a nearly optimal solution in a finite number of iterations. We also consider the use of this algorithm in a trust region Newton's method. In particular, we prove that under reasonable assumptions the sequence generated by Newton's method has a limit point which satisfies the first and second order necessary conditions for a minimizer of the objective function. Numerical results for GQTPAR, which is a Fortran implementation of our algorithm, show that GQTPAR is quite succesful in a trust region method. In our tests a call to GQTPAR only required 1.6 iterations on the average.

23377 When not to use an automatic quadrature routine. Lyness, J.N. (Argonne National Lab., IL). *SIAM (Society for Industrial and Applied Mathematics) Review;* **25**: No. 1, 63-87(Jan 1983). Contract W-31-109-ENG-38.

Numerical quadrature is required as a component in many large scale (and small scale) scientific programs. Frequently the scientist faces a choice. Either he may use one of the comparatively recent automatic quadrature routines (AQR) or he may use a standard rule evaluation quadrature routine (REQR) based directly on traditional formulae. The purpose of this article is to help the scientist to make an informed choice. In the first half of this article we introduce some generic properties of AQRs. The more straightforward of these are those concerned with reliability and economy. Less straightforward is the vital performance profile property. The second half of this article is devoted principally to demonstrating how in some calculations the jagged performance profile associated with the AQR can cause other parts of the overall program to be far more expensive than necessary. Thus, while in many programs, the use of an AQR can save significant human time, in many other programs, its use can be a disaster. There is no information in this article about particular AQRs or REQRs. This article is concerned only with generic properties of these two fundamentally different categories of numerical software.

9903 Information Handling

23378 (EGG-IS—6494(2-85)) INEL User Network Exchange. Volume 2-85, March/April 1985. Williams, T.L. (ed.). (EG and G Idaho, Inc., Idaho Falls (USA). Operations and Data Processing Div.). 1985. Contract AC07-76ID01570. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009171.

The categories in which information is presented are as follows: informative articles on computer systems, software, special projects, etc.; changes to hardware, software, computer services, etc., and how they affect the user; articles and change information concerning INEL business application systems, i.e., IMMS, CAPS, etc.; description of available user training courses; brief announcements or information items for communication to special user groups and/or the general user community; and brief descriptions of vendor software available at the INEL.

CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC05-84OT21400	**Martin Marietta Energy Systems, Oak Ridge, TN (USA)**	
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AC06-76RL01830	**Pacific Northwest Labs., Richland, WA (USA)**	
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AC07-76GJ01664	Bendix Field Engineering Corp., Grand Junction, CO (USA)	
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	Idaho National Engineering Lab., Idaho Falls (USA)	
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	EG and G Idaho, Inc., Idaho Falls (USA). Operations and Data Processing Div.	
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AC07-77ET28301	Terra Tek Research, Salt Lake City, UT (USA)	
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	10:23094	EGG/10282—1049
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AC09-76SR00001	Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering	
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AC21-82MC19163	Scientific Design Co., Inc., New York (USA)	
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AC22-80PC30021	Air Products and Chemicals, Inc., Allentown, PA (USA)	
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AC22-81PC40784	Pennsylvania State Univ., University Park (USA)	
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AC22-82PC50041	Catalytic, Inc., Wilsonville, AL (USA)	
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AC22-83PC60047	Cities Service Research and Development Co., Tulsa, OK (USA)	
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AC22-83PC60576	Standard Research Corp., Arcadia, CA (USA)	
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AC22-84PC70507	**Avco-Everett Research Lab., Everett, MA (USA)**	
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AC22-84PC70508	**TRW Energy Development Group, Redondo Beach, CA (USA)**	
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AC79-81BP24574	**Oregon Univ., Eugene (USA). Solar Radiation Monitoring Lab.**	
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AC85-84AP10062	**Ebasco Services, Inc., Bellevue, WA (USA)**	
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AI05-83ER52092	**Naval Research Lab., Washington, DC (USA). Plasma Physics Div.**	
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AS05-81ER10840	**Kentucky Univ., Lexington (USA)**	
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AS05-81ER40039	**Texas A and M Univ., College Station (USA). Dept. of Physics**	
	10:23235	DOE/ER/40039—11
AS05-83ER60159	**Georgia State Univ., Atlanta (USA)**	
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AS08-81DP40142	**Department of Physics, University of Illinois at Chicago, P. O.Xx 4348, Chicago, Illinois 60680**	
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AS08-83DP40190	**California Univ., Los Angeles (USA). Dept. of Physics**	
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AS09-79ER10499	**Univ. of Georgia, Athens**	
	10:23116	Philosophical Transactions of the Royal Society of London B298 443-466 (1982).
AS20-82LC10934	**Denver Research Inst., CO (USA)**	
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AT02-76CH91005	**Combustion Engineering, Inc., Windsor, CT (USA)**	
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AT03-76ER70227	**Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, Cal**	
	10:22858	Journal of Applied Physics 57 NO. 8. 3115-3117 (15 Apr 1985).
AT03-76ER72012	**Max Planck Institut fuer Plasmaphysik, D8046 Garching, West Germany**	
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AT03-76ET53019	**Department of Physics, University of California, Los Angeles, California 90024**	
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AT03-76EV70156	**Univ. of California, Berkeley**	
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AT03-79EV10277	**Univ. of California, Berkeley**	
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AT03-81ER10934	**University of Utah, Salt Lake City, Utah 84112**	
	10:22915	Journal of Applied Physics 57 NO. 10. 4817-4819 (15 May 1985).
AT03-82SF11669	**Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.**	
	10:22437	ESG-DOE—13507
AT03-83ER45012	**University of Southern California, Los Angeles (USA)**	
	10:22891	DOE/ER/45012—T1
AT03-84ER53158	**GA Technologies, Inc., San Diego, California 92138**	
	10:23310	Physics of Fluids 28 NO. 5. 1371-1378 (May 1985).
AT06-76ET11286	**Oregon State Univ., Corvallis (USA)**	
	10:22500	DOE/ET/11286—29
FC01-80ET23197	**Solarex Corp., Rockville, MD (USA)**	
	10:22521	DOE/ET/23197—T11
FC02-80CS30334	**Missouri Univ., Columbia (USA). Dept. of Nuclear Engineering**	
	10:22571	DOE/CS/30334—T2
FC02-82CE30737	**Fleetwood Homes, Inc., Worthington, MN (USA)**	
	10:22570	DOE/CE/30737—1
FC03-79ET27196	**Imperial, County of, El Centro, CA (USA). Dept. of Public Works**	
	10:22587	DOE/ET/27196—T18
FC04-82AL16333	**Advanco Corp., El Segundo, CA (USA)**	
	10:22559	DOE/AL/16333—1
FC07-80ID12128	**Tallahassee, City of, FL (USA)**	
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	10:22944	DOE/ER/45107—1
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	10:22307	DOE/FE/60181—103
	10:22319	DOE/FE/60181—115
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FC22-83FE60339	Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center	
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FG01-77CS20435	National Research Council, Washington, DC (USA). Building Research Advisory Board	
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FG01-80RA50094	Robertson (Thomas A.), Washington, DC (USA)	
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FG01-82CE64827	Blue Cross and Blue Shield Association, Chicago, IL (USA)	
	10:22772	DOE/CE/64827—T2
FG01-82ER60075	National Research Council, Washington, DC (USA). Committee on Permafrost	
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FG01-82PE70040	Resource Systems Inst., Honolulu, HI (USA)	
	10:22374	DOE/PE/70040—1
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FG02-76CS60014	Minnesota Dept. of Energy and Economic Development, St. Paul (USA). Energy Div.	
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	10:22775	DOE/CS/60014—8
FG02-79ER10538	Ohio State Univ., Columbus	
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FG02-82ER10275	American Nuclear Society, La Grange Park, IL	
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FG02-84ER13256	Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science	
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FG02-84ER40158	Centre de Physique Theorique, Centre National de la Recherche Scientifique, Marseille, France	
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FG02-84ER45070	Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences	
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FG02-84ER45080	Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy	
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FG02-84ER45158	Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering	
	10:22837	DOE/ER/45158—T1
FG02-84ER45170	Missouri Univ., Kansas City (USA)	
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FG02-84ER45173	Minnesota Univ., Minneapolis (USA). Corrosion Research Center	
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FG02-84ER53179	Syracuse Univ., NY (USA). Dept. of Physics	
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FG05-84ER40162	Georgia State Univ., Atlanta (USA). Dept. of Physics and Astronomy	
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FG05-84ER45128	Clark Coll., Atlanta, GA (USA). Dept. of Physics	
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FG05-84ER45134	Department of Physics, West Virginia University, Morgantown, West Virginia 26506-6023	
	10:22859	Journal of Applied Physics 57 NO. 8. 3188-3190 (15 Apr 1985).
FG22-81PC40783	Pennsylvania State Univ., University Park (USA). Dept. of Chemistry	
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FG22-84PC70776	California Univ., Berkeley (USA). Coll. of Engineering	
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	10:23375	SIAM Journal on Scientific and Statistical Computing 4 NO. 4. 712-719 (Dec 1983).
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W-7405-ENG-26	**Oak Ridge National Lab., TN**	
	10:22900	Journal of the American Ceramic Society 66 NO. 8. 120-121 (Aug 1983).
	10:22932	Analytical Chemistry 56 NO. 8. 1348-1350 (Jul 1984).
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1-Rev.1	*See* UCRL-91882-Rev.1	E 1.99: DE85008959	MN -32	10:23371
CONF-8410238-	(American Society for Metals meeting, Long Beach, CA, USA, 31 Oct-2 Nov 1984)			
2	*See* SAND-85-0750C	E 1.99: DE85009542	MN -25	10:22850
CONF-8410245-	(Occupational health and safety symposium, Wilmington, DE, USA, 3-5 Oct 1984)			
1-Rev.	*See* DP-MS-84-116-Rev.12-84	E 1.99: DE85007908	MN -41	10:23149
CONF-8410257-	(Beryllium sub-working group meeting, Aldermaston, UK, 1 Oct 1984)			
1	*See* UCRL-90661	E 1.99: DE85007930	MN -41	10:23156
CONF-841105-	(Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, Washington, DC, USA, 11-16 Nov 1984)			
65	*See* HEDL-SA-3169-FP	E 1.99: DE85008553	MN -80	10:22655
CONF-841187-	(5. DOE environmental protection information meeting, Albuquerque, NM, USA, 6-8 Nov 1984)			
29	*See* PNL-SA-12441	E 1.99: DE85005289	MN -41	10:22467
CONF-8411101-	(3. annual western gas sands sub-program review, Morgantown, WV, USA, 7-8 Nov 1984)			
	See DOE/METC-85-7	E 1.99: DE85001961	STD -92a	10:22384
CONF-8411140-	(ARO workshop on new computing environments: parellel, vector and systolic, Stanford, CA, USA, 7-9 Nov 1984)			
3-Rev.1	*See* UCRL-92007-Rev.1	E 1.99: DE85009447	MN -32	10:23372
CONF-8411153-	(International conference on lasers '84, San Francisco, CA, USA, 26-30 Nov 1984)			
3	*See* LBL-18651	E 1.99: DE85008515	MN -4	10:22950
CONF-8411158-	(3. biennial southern silvicultural research conference, Atlanta, GA, USA, 7-8 Nov 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85008187	MN -61F	10:22519
CONF-8411159-	(Pacific Basin biofuel workshop, Honolulu, HI, USA, 1-2 Nov 1984)			
1	*See* HNEI-84-S02	DE85901276	MN -61	10:22526
CONF-841210-	(International chemical congress of Pacific Basin Society, Honolulu, HI, USA, 16-21 Dec 1984)			
21	*See* DOE/ER/10489-20	E 1.99: DE85008546	MN -4	10:22928
CONF-841246-	(1. international conference on fusion reactor materials, Tokyo, Japan, 3-6 Dec 1984)			
20-Draft	*See* HEDL-SA-3181-FP-Draft	E 1.99: DE85007464	MN -20c	10:23339
CONF-850103-	(2. symposium on space nuclear power systems, Albuquerque, NM, USA, 14-16 Jan 1985)			
8	*See* BNL-36043	E 1.99: DE85008290	MN -77	10:22638
CONF-850107-	(10. annual workshop on geothermal reservoir engineering, Stanford, CA, USA, 22-24 Jan 1985)			
8	*See* LBL-19092	E 1.99: DE85008680	MN -66a	10:22590
CONF-850108-	(SCS multiconference on modeling and simulation, San Diego, CA, USA, 24-26 Jan 1985)			
5	*See* PNL-SA-12584	E 1.99: DE85007501	MN -80	10:22713
CONF-850122-	(9. annual conference on composites and advanced ceramic materials and workshop on testing methods for ceramic matrix composites, Cocoa Beach, FL, USA, 20-24 Jan 1985)			
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85007945	MN -25	10:22888
CONF-850123-	(American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting, Chicago, IL, USA, 27-31 Jan 1985)			
2	*See* LBL-17457	E 1.99: DE85009933	MN -95d	10:22796

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CONF-850128-	(2. international workshop on laser acceleration of particles, Los Angeles, CA, USA, 7-18 Jan 1985)			
5	*See* LBL-19064	E 1.99: DE85008455	MN -28	10:23014
7	*See* LA-UR-85-882	E 1.99: DE85009547	MN -28	10:23009
CONF-850136-	(23. AIAA aerospace sciences meeting, Reno, NV, USA, 14-17 Jan 1985)			
6	*See* N-85-11133			10:22528
CONF-850141-	(13. international workshop on gross properties of nuclei and nuclear excitations, Hirschegg, Austria, 14-19 Jan 1985)			
4	*See* LBL-19032	E 1.99: DE85009937	MN -34C	10:23270
CONF-850142-	(Arizona State University centennial symposium on high-resolution electron microscopy, Tempe, AZ, USA, 7-11 Jan 1985)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85007932	MN -25	10:22924
CONF-850150-	(1. regional conference on university teaching, Las Cruces, NM, USA, 9 Jan 1985)			
2	*See* LA-UR-85-16	E 1.99: DE85005907	MN -32	10:23368
CONF-850152-	(3. LEAR workshop, Tignes-Savoie, France, 19-26 Jan 1985)			
2	*See* LA-UR-85-1092	E 1.99: DE85009601	MN -34D	10:23249
CONF-850164-	(FNAL/ANL workshop on charged particle accelerators for cancer therapy, Batavia, IL, USA, 24-25 Jan 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85007953	MN -48	10:23125
CONF-850165-	(Conference on solitons and coherent structures, Santa Barbara, CA, USA, 11-16 Jan 1985)			
2	*See* LA-UR-85-848	E 1.99: DE85009578	MN -34	10:23225
CONF-850166-	(8. annual Arnold O. Beckman conference in clinical chemistry, San Diego, CA, USA, 28-30 Jan 1985)			
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85008151	MN -48	10:23126
CONF-850169-	(7. international conference on positron annihilation, New Delhi, India, 6-11 Jan 1985)			
2	*See* UCRL-92349	E 1.99: DE85008967	MN -25	10:22851
CONF-850206-	(International ANS/ENS topical meeting on probabilistic safety methods and applications, San Francisco, CA, USA, 24 Feb-1 Mar 1985)			
26	*See* PNL-SA-12550	TI85007406	MN -78	10:22712
CONF-850211-	(114. AIME annual meeting (includes Society of Mining Engineers), New York, NY, USA, 24-28 Feb 1985)			
8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009275	MN -90a	10:22306
CONF-850240-	(Alternative energy in the Midwest: research and applications, Schaumburg, IL, USA, 21-23 Feb 1985)			
3	*See* PNL-SA-12938	E 1.99: DE85008517	MN -61D	10:22489
CONF-850252-	(Solar thermal research program annual conference, Denver, CO, USA, 20-22 Feb 1985)			
4	*See* SERI/TP-255-2670	E 1.99: DE85008782	MN -62a	10:22583
CONF-850267-	(2. international conference on ultrastructure processing of ceramics, glasses and composites, Daytona Beach, FL, USA, 25 Feb-1 Mar 1985)			
3	*See* SAND-84-2564C	E 1.99: DE85009107	MN -38	10:22893
CONF-850272-	(Candle Users Group meeting, Los Angeles, CA, USA, 21-22 Feb 1985)			
1	*See* SLAC-PUB-3565	E 1.99: DE85009115	MN -28	10:23370
CONF-850273-	(Topical meeting on microphysics of surfaces, beams and adsorbates, Santa Fe, NM, USA, 4-6 Feb 1985)			
1	*See* SAND-84-2114C	E 1.99: DE85007885	MN -34A	10:23210
CONF-850274-	(International conference on corrosion science and technology, Calcutta, India, 21-23 Feb 1985)			
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85009706	MN -25	10:22833
CONF-850275-	(2. national conference and exposition on surface and borehole geophysical methods in ground water investigations, Ft. Worth, TX, USA, 12-14 Feb 1985)			
1	*See* LBL-19106	E 1.99: DE85008683	MN -11	10:23101
CONF-850301-	(12. annual energy technology conference and exposition, Washington, DC, USA, 25-27 Mar 1985)			
2	*See* EGG-M-06285	E 1.99: DE85008936	MN -95f	10:22812
CONF-850302-	(8. international conference on fluidized bed combustion, Houston, TX, USA, 18-21 Mar 1985)			
1	*See* DOE/FE/60181-105	E 1.99: DE85008635	MN -90	10:22344
CONF-850310-	(6. topical meeting on the technology of fusion energy, San Francisco, CA, USA, 3-7 Mar 1985)			
42	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009292	MN -20	10:23327
43	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009323	MN -20	10:23328
44	*See* LA-UR-85-752	E 1.99: DE85009591	MN -20d	10:23340
45	*See* LA-UR-85-753	E 1.99: DE85009592	MN -20	10:23341
CONF-850314-	(Waste management '85, Tucson, AZ, USA, 24-28 Mar 1985)			
23	*See* EGG-M-02084	E 1.99: DE85008582	MN -70B	10:22433
25	*See* EGG-M-21284	E 1.99: DE85008648	MN -70	10:22435
26	*See* EGG-02184	E 1.99: DE85008651	MN -70	10:22431
28	*See* UCRL-92272	E 1.99: DE85008971	MN -71	10:22982
30	*See* UCRL-91019	E 1.99: TI85008954	MN -85	10:22414

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31	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009524	MN -70B	10:22419
32	*See* SAND-84-2039C	E 1.99: DE85009339	MN -71	10:22413
33	*See* SAND-84-2001C	E 1.99: DE85009335	MN -71	10:22412
34	*See* SAND-84-1823C	E 1.99: DE85009334	MN -71	10:22979
35	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009287	MN -70	10:23092
37	*See* PNL-SA-12626	E 1.99: DE85009128	MN -71	10:22977
38	*See* PNL-SA-12571	E 1.99: DE85009430	MN -70	10:22446
39	*See* PNL-SA-12614	E 1.99: DE85009316	MN -70	10:22447
41	*See* LA-UR-85-785	E 1.99: DE85009570	MN -70B	10:22439
42	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009720	MN -70	10:22420
43	*See* PNL-SA-12586	E 1.99: DE85009434	MN -86	10:22409
44	*See* BNL-NUREG-36197	TI85009764	MN -70	10:22459
46	*See* PNL-SA-12569	E 1.99: DE85009433	MN -70B	10:22461
47	*See* SAND-84-1958C	E 1.99: DE85010069	MN -70	10:22452
55	*See* BNL-NUREG-36149	TI85009765	MN -70B	10:22418
CONF-850345-	(Southwest conference on optics, Albuquerque, NM, USA, 4-8 Mar 1985)			
6	*See* SAND-84-2678C	E 1.99: DE85009501	MN -38	10:23039
7	*See* SAND-84-2663C	E 1.99: DE85009148	MN -63e	10:22532
8	*See* PNL-SA-12997	E 1.99: DE85009431	MN -37	10:22910
CONF-850357-	(Spring national meeting of AIChE, Houston, TX, USA, 24-28 Mar 1985)			
3	*See* LBL-18947	E 1.99: DE85008442	MN -92a	10:22369
5	*See* DOE/FE/60181-103	E 1.99: DE85008504	MN -90i	10:22307
6	*See* DOE/FE/60181-115	E 1.99: DE85008634	MN -90i	10:22319
8	*See* LA-UR-85-1066	E 1.99: DE85009595	MN -25	10:22892
CONF-8503114-	(SUGI/SAS Users Group international conference, Reno, NV, USA, 10-13 Mar 1985)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85008356	MN -11	10:23067
CONF-8503117-	(Workshop on parallel processing using the heterogeneous element processor, Norman, OK, USA, 20-21 Mar 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85007899	MN -32	10:23365
CONF-8503118-	(32. PSI annual secretarial institute, Knoxville, TN, USA, 6 Mar 1985)			
1	*See* Y/DL-914	E 1.99: DE85008154	MN -13	10:23374
CONF-8503119-	(Softool User's Group meeting, Dallas, TX, USA, 25-26 Mar 1985)			
1	*See* LA-UR-85-854	E 1.99: DE85009579	MN -32	10:23019
CONF-8503120-	(Hadronic probes and nuclear interactions conference, Tempe, AZ, USA, 11-14 Mar 1985)			
1	*See* LA-UR-85-837	E 1.99: DE85009577	MN -34D	10:23236
CONF-8503121-	(American Society of Nondestructive Testing spring conference, Washington, DC, USA, 11-14 Mar 1985)			
1	*See* UCRL-92271	E 1.99: DE85008961	MN -25	10:22997
CONF-8503125-	(Symposium on aneuploidy: etiology and mechanisms, Washington, DC, USA, 25-29 Mar 1985)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009295	MN -48	10:23119
CONF-850405-	(2. national topical meeting on tritium technology in fission, fusion and isotopic applications, Dayton, OH, USA, 30 Apr-2 May 1985)			
3	*See* LA-UR-85-962	E 1.99: DE85009568	MN -20d	10:23342
4	*See* LA-UR-85-983	E 1.99: DE85009636	MN -20d	10:23343
CONF-850410-	(ANS/ENS fast reactor safety meeting, Knoxville, TN, USA, 21-24 Apr 1985)			
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85002774	MN -79p	10:22670
CONF-850415-	(4. international conference on wear of materials, Vancouver, Canada, 14-18 Apr 1985)			
2	*See* LBL-18255	E 1.99: DE85008446	MN -25	10:22840
CONF-850427-	(Western synfuels symposium, Grand Junction, CO, USA, 24-26 Apr 1985)			
1	*See* DOE/FE/60181-132	E 1.99: DE85009784	MN -90	10:22278
CONF-850444-	(Newer coal technologies: implications for energy and development policies in Asia and the Pacific, Honolulu, HI, USA, 17-24 Apr 1985)			
1	*See* DOE/FE/60181-133	E 1.99: DE85009785	MN -90	10:22345
CONF-850499-	(9. conference on advances in the production of tubes, bars and shapes, Cincinnati, OH, USA, 22-24 Apr 1985)			
1	*See* DP-MS-85-10	E 1.99: DE85008257	MN -25	10:22839
CONF-8504100-	(2. Copper Mountain conference on multigrid methods, Copper Mountain, CO, USA, 1-3 Apr 1985)			
1	*See* UCRL-92211	E 1.99: DE85007929	MN -32	10:23373
CONF-8504101-	(18. oil shale symposium, Grand Junction, CO, USA, 22-24 Apr 1985)			
1-Rev.1	*See* UCRL-91927-Rev.1	E 1.99: DE85009448	MN -91	10:22298
CONF-8504102-	(66. AWS annual meeting, Las Vegas, NV, USA, 28 Apr-3 May 1985)			
1	*See* SAND-85-0697C	E 1.99: DE85009337	MN -38	10:22849
CONF-850504-	(Particle accelerator conference, Vancouver, Canada, 13-16 May 1985)			
1	*See* LA-UR-85-954	E 1.99: DE85009569	MN -28	10:23012
2	*See* LA-UR-85-1021	E 1.99: DE85009630	MN -28	10:23013

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CONF-850536-	(American Ceramic Society annual meeting, Cincinnati, OH, USA, 5-9 May 1985)				
1	*See* DP-MS-84-122	E 1.99:	DE85003659	MN -70	10:22425
CONF-850542-	(167. Electrochemical Society meeting, Toronto, Ontario, Canada, 12-17 May 1985)				
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85004074	MN -25	10:22834
CONF-850581-	(17. conference on agriculture and forest meteorology, Phoenix, AZ, USA, 20-24 May 1985)				
1	*See* PNL-SA-12826	E 1.99:	DE85007148	MN -41	10:23060
2	*See* DP-MS-84-118	E 1.99:	DE85007910	MN -11	10:23069
CONF-850582-	(31. ISA international instrumentation symposium, San Diego, CA, USA, 6-9 May 1985)				
1	*See* DP-MS-84-127	E 1.99:	DE85005860	MN -70	10:22426
3	*See* SAND-85-0284C		TI85006899	MN -80	10:22714
4	*See* EGG/10282-1077	E 1.99:	DE85008644	MN -37	10:23042
6	*See* EGG-M-04185		DE85009175	MN -78	10:22675
CONF-850585-	(Instrument Society of America conference - DIGITECH/85, Boston, MA, USA, 14-16 May 1985)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85006882	MN -41	10:23066
CONF-8506107-	(Society of Women Engineers conference, Minneapolis, MN, USA, 27-30 Jun 1985)				
1	*See* EGG-M-08785		DE85009878	MN -70	10:22434
CONF-850706-	(8. international symposium on detonation, Albuquerque, NM, USA, 15-19 Jul 1985)				
11	*See* LA-UR-85-1114	E 1.99:	DE85009604	MN -45	10:23049
12	*See* LA-UR-85-1129	E 1.99:	DE85009608	MN -45	10:23050
CONF-850801-	(International symposium on geothermal energy, Kailua Kona, HI, USA, 26-30 Aug 1985)				
26	*See* LA-UR-85-884	E 1.99:	DE85009549	MN -66b	10:23005
CONF-850809-	(8. international conference on structural mechanics in reactor technology, Brussels, Belgium, 19-23 Aug 1985)				
45	*See* UCRL-91251	E 1.99:	TI85008296	MN -78	10:22715
CONF-851054-	(Society of Mining Engineers fall meeting, Albuquerque, NM, USA, 16-18 Oct 1985)				
1	*See* EGG-M-04785	E 1.99:	DE85009109	MN -11	10:23180
COO-					
2426-203	*See* DOE/CH/91005-T1	E 1.99:	DE85004664	MN -78	10:22628
4014-10	*See* DOE/ET/34205-T2	E 1.99:	DE85004668	MN -78	10:22625
4711-05	*See* DOE/ET/34212-T3	E 1.99:	DE85005401	MN -78	10:22629
4939-7	*See* DOE/ER/04939-7	E 1.99:	DE85008624	MN -4	10:22962
6818-1	NTIS, PC A17/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007323	MN -13	10:22623
CR-					
21/ 84	*See* PB-85-139426/XAB				10:22323
DES-					
75-38	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009654	MN -11	10:23104
DIA-DST-					
2700Z-004-84	*See* AD-A-149113/3/XAB				10:22988
DOE/AL/10732-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010126	MN -22	10:22989
DOE/AL/10749-					
T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007035	MN -59A	10:22580
DOE/AL/16333-					
1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009038	MN -62	10:22559
DOE/AP/10062-					
T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007852	MN -97	10:22617
DOE/BP-					
236	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009856	MN -97e	10:22475
262-Vol.1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008022	MN -97a	10:22744
401	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007809	MN -97	10:22608
408	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009670	MN -11	10:22512
16380-1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009343	MN -11	10:23103
DOE/BP/24574-					
1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009773	MN -62	10:22517
DOE/CE/30719-					
T3	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99:	DE85009732	MN -64	10:22567
DOE/CE/30737-					
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85006855	STD -59B	10:22570
DOE/CE/50036-					
1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009539	STD -11	10:22490
DOE/CE/64827-					
T2	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE85003100	MN -95d	10:22772
DOE/CH-					
1	NTIS, PC A18/MF A01 (GPO Dep.)	E 1.99:	DE85009892	STD -70	10:22421
10(1)	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85006286	STD -70	10:22422
10(2)	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85006285	STD -70	10:22423
DOE/CH/91005-					
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85004664	MN -78	10:22628
DOE/CS/20435-					
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010201	MN -95d	10:22773
DOE/CS/30334-					
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008920	MN -59B	10:22571
DOE/CS/40403-					
1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007162	MN -95f	10:22739

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2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007163	MN -95f	10:22740
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007165	MN -95f	10:22741
DOE/CS/54209-					
25	NTIS, PC A08; 3 (GPO Dep.)	E 1.99:	DE85006661	STD -96	10:22826
DOE/CS/60014-					
7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010148	MN -95	10:22774
8	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85010147	MN -95d	10:22775
DOE/DP/40190-					
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008335	MN -20	10:23329
DOE/EA-					
0251	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009801	MN -11	10:23105
0253	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008487	MN -11	10:23106
DOE/EIA-					
0125(84/ 40)	NTIS, PC A09/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	DE85009890	MN -98A	10:22332
0380(84/ 09)	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	E 1.99:	DE85004291	MN -98B	10:22373
0455(83)	NTIS, PC A11/MF A01 - GPO (GPO Dep.)	E 1.99:	DE85010006	MN -98E	10:22745
M005	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE85010938	MN -98	10:22742
DOE/EIS-					
0077-DS	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE85008871	MN -97a	10:23096
0077-SDR	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008842	MN -97a	10:23097
DOE/ER-					
0046/ 20	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009869	STD -20c	10:23330
0214	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009861	MN -20	10:23291
0223	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009993	STD -34D	10:23234
DOE/ER/03898-					
T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE85008639	MN -4	10:22955
DOE/ER/04049-					
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009472	MN -23	10:22903
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009427	MN -4	10:22925
DOE/ER/04939-					
7	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008624	MN -4	10:22962
DOE/ER/10096-					
T17	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85011086	MN -61E	10:22491
DOE/ER/10275-					
1B	NTIS, PC A04/MF A01; 1		DE83004081	MN -2	10:22648
DOE/ER/10489-					
20	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008546	MN -4	10:22928
21	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009041	MN -4	10:22929
DOE/ER/10718-					
1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008459	MN -32	10:23366
DOE/ER/10720-					
16	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010136	MN -4	10:22492
DOE/ER/12019-					
T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009419	MN -38	10:23041
DOE/ER/12065-					
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85007735	MN -25	10:22836
DOE/ER/12095-					
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009726	MN -48	10:23135
DOE/ER/13256-					
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009812	MN -4	10:22943
DOE/ER/13262-					
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009321	MN -34A	10:23205
DOE/ER/30050-					
T1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008670	MN -13	10:22737
DOE/ER/40039-					
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008369	MN -34B	10:23235
DOE/ER/40141-					
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008094	MN -34D	10:23242
DOE/ER/40162-					
1	NTIS, PC A02; 3		DE85009319	MN -34C	10:23264
DOE/ER/45006-					
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009722	MN -25	10:22890
DOE/ER/45012-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008846	MN -25	10:22891
DOE/ER/45070-					
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008729	MN -37	10:22520
DOE/ER/45072-					
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009452	MN -34A	10:23206
DOE/ER/45080-					
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009811	MN -25	10:23278
DOE/ER/45107-					
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008571	MN -4	10:22944
DOE/ER/45128-					
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009882	MN -25	10:22904
DOE/ER/45158-					
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008572	MN -25	10:22837
DOE/ER/45170-					
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010022	MN -25	10:22905
DOE/ER/45173-					
1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE85009418	MN -25	10:22838
DOE/ER/52092-					
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009962	MN -20a	10:23335
DOE/ER/53169-					
T1	NTIS, PC A03; 3		DE85008642	MN -20	10:23299

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
DOE/ER/53179-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009019	MN -20g	10:23336
DOE/ER/60075-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85009402	MN -11	10:23172
DOE/ER/60110-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85007062	STD -48	10:23146
DOE/ER/60159-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009881	MN -4	10:22952
DOE/ET/10815-98	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85007770	STD -90g	10:22753
DOE/ET/11286-29	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE85006952	MN -61A	10:22500
DOE/ET/12439-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85008733	MN -38	10:22821
DOE/ET/15020-1634-Vol.5	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85004574	STD -90e	10:22609
DOE/ET/20624-T11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85006773	MN -63	10:22547
DOE/ET/20626-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85008188	STD -63c	10:22548
DOE/ET/23197-T11	NTIS, PC A15/MF A01 (GPO Dep.)	E 1.99: DE85007695	STD -63b	10:22521
DOE/ET/27196-T18	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008735	MN -66	10:22587
DOE/ET/28301-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85010301	STD -66a	10:22591
DOE/ET/34034-113	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85008232	MN -77	10:22639
DOE/ET/34205-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85004668	MN -78	10:22625
DOE/ET/34212-T3	NTIS (US Sales Only), PC A02/MF A01 (GPO Dep.)	E 1.99: DE85005401	MN -78	10:22629
DOE/ET/53088-168	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85010085	MN -20	10:23300
DOE/EV/03631-13-Pt.1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008667	MN -48	10:23147
13-Pt.2-Rev.	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85008934	MN -48	10:23148
DOE/FC/10620-01	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008226	MN -90	10:22277
DOE/FE/60181-103	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008504	MN -90i	10:22307
105	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85008635	MN -90	10:22344
115	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008634	MN -90i	10:22319
132	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009784	MN -90	10:22278
133	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85009785	MN -90	10:22345
DOE/FE/60339-T11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009119	STD -90a	10:22279
DOE/ID/12128-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85008027	STD -97e	10:22513
DOE/IG-0217	TIC; 1	TI85008483	STD -13	10:23359
DOE/IR/10984-1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85008625	MN -13	10:22818
DOE/JPL/956679-84/ 5	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85009809	STD -63b	10:22522
DOE/JPL/956831-3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009651	STD -63b	10:22523
DOE/LC/10934-1697	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85003285	STD -90d	10:22320
DOE/MA-0138/ 4	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE85009983	MN -13	10:23360
0139/ 4	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE85009947	MN -13	10:23361
DOE/MC/16545-1666	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE85003382	STD -90d	10:22280
DOE/MC/19163-1776	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85003384	STD -90c	10:22281
1777	NTIS, PC A24/MF A01; 1 (GPO Dep.)	E 1.99: DE85003383	STD -90c	10:22282
1779	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85003386	STD -90c	10:22283
1780	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE85003387	STD -90c	10:22284
1786	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85003390	STD -90c	10:22285
DOE/METC-85-7	NTIS, PC A23/MF A01; 1 (GPO Dep.)	E 1.99: DE85001961	STD -92a	10:22384
85/ 15	NTIS PC $23.00/MF A01 (GPO Dep.)	E 1.99: DE85004565	STD -93A	10:22760
DOE/METC/SP-216	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85001983	STD -92a	10:22385
DOE/NASA-0238-1	*See* N-85-11455			10:22761
DOE/NBM-5000125	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85000125	STD -92a	10:22371
5009034	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85009034	STD -97d	10:22746
5009236	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85009236	MN -79	10:22640
5009454	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99: DE85009454	MN -13	10:22272
5009475	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE85009475	MN -13	10:22273

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DOE/NDC-35	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009974	MN -22	10:22471
DOE/PC/30021-T17	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008457	STD -90d	10:22477
DOE/PC/40783-T17	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008166	STD -90d	10:22321
DOE/PC/40784-T6	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE85009130	STD -90d	10:22286
DOE/PC/40792-T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85005908	MN -90c	10:22287
DOE/PC/40796-11a	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007649	MN -90e	10:22346
11b	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007650	MN -90e	10:22347
12a	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007651	MN -90e	10:22348
DOE/PC/50041-48	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009865	STD -90d	10:22288
DOE/PC/50796-T8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008870	MN -90a	10:22940
DOE/PC/50808-T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009062	MN -90a	10:22349
DOE/PC/50809-T9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008824	MN -90a	10:22308
DOE/PC/50816-9	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85006666	STD -90d	10:22478
DOE/PC/52274-T6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85005440	MN -88	10:22333
DOE/PC/60047-T6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008132	STD -90d	10:22289
DOE/PC/60420-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009079	MN -90e	10:22350
T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009078	MN -90e	10:22351
DOE/PC/60785-6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007480	STD -90d	10:22309
DOE/PC/60800-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007880	MN -90c	10:22290
DOE/PC/70057-T1	NTIS, PC A03/MF A01; 1		DE85002986	STD -90a	10:22338
T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008867	MN -90a	10:22339
DOE/PC/70507-2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008305	STD -90g	10:22754
DOE/PC/70508-T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008822	STD -90g	10:22755
DOE/PC/70776-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008502	MN -90a	10:22310
DOE/PC/70787-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008657	MN -90d	10:22291
DOE/PC/70795-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008254	MN -90a	10:22311
DOE/PC/70799-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007878	MN -90d	10:22312
T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008490	MN -90d	10:22313
DOE/PC/70803-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008148	MN -90	10:22340
DOE/PC/71253-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007366	MN -90i	10:23068
DOE/PE/70040-1	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99:	DE85010321	MN -92	10:22374
2	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85010328	MN -92	10:22375
DOE/PETC/TR-85/6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009791	STD -90i	10:22327
DOE/PO/10850-4-Vol.1	NTIS, PC A21/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009906	STD -92	10:22378
4-Vol.2	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009905	STD -92	10:22379
4-Vol.3	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009907	STD -92	10:22380
DOE/R3/02392-T1	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85009253	MN -61E	10:22493
DOE/R3/02400-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009271	MN -59B	10:22572
DOE/R3/02408-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE85008994	MN -95d	10:22777
DOE/R3/02412-T1	NTIS, PC A02; 3		DE85009182	MN -95d	10:22778
DOE/R3/02414-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009183	MN -95d	10:22779
DOE/R3/02421-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008991	MN -95d	10:22501
DOE/R3/02425-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008987	MN -60	10:22592
DOE/R3/02430-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009266	MN -95d	10:22780
DOE/R3/02444-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008983	MN -95f	10:22807
DOE/R3/02446-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009210	MN -95d	10:22781

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DOE/R3/02447-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85008982	MN -95d	10:22782
DOE/R3/06044-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009249	MN -95e	10:22816
DOE/R3/06048-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009260	MN -95	10:22783
DOE/R3/06049-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85009217	MN -95d	10:22784
DOE/R3/06056-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009212	MN -95d	10:22785
DOE/R3/06063-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85008988	MN -61B	10:22524
DOE/R3/06070-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009424	MN -95d	10:22502
DOE/R3/06077-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85008997	MN -59B	10:22573
DOE/R3/06078-T1	NTIS, PC A03; 3	DE85009194	MN -59A	10:22574
DOE/R3/06079-T1	NTIS, PC A04; 3	DE85009170	MN -97e	10:22509
DOE/R3/06084-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009400	MN -61E	10:22494
DOE/R3/06086-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009202	MN -95d	10:22786
DOE/R3/06089-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009303	MN -95e	10:22817
DOE/R3/06091-T1	NTIS, PC A07; 3	DE85009420	MN -61F	10:22495
DOE/R3/06092-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009192	MN -95d	10:22787
DOE/R3/06098-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009190	MN -95e	10:22808
DOE/R3/06100-T1	NTIS, PC A07; 3	DE85009421	MN -96	10:22829
DOE/R3/06102-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009220	MN -95d	10:22809
DOE/R3/06103-T1	NTIS, PC A02; 3	DE85008981	MN -59B	10:22575
DOE/R3/06107-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85009248	MN -95d	10:22788
DOE/R3/06109-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85009154	MN -95f	10:22789
DOE/R3/06111-T1	NTIS, PC A07; 3	DE85008992	MN -95e	10:22503
DOE/R3/06116-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009242	MN -97e	10:22515
DOE/R3/06122-T1	NTIS, PC A09; 3	DE85009000	MN -11	10:22613
DOE/R3/06263-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010171	MN -61E	10:22496
DOE/R3/06264-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010168	MN -61E	10:22819
DOE/R3/06268-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009328	MN -61	10:22479
DOE/R3/08054-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85009511	MN -95d	10:22504
DOE/R3/08056-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009516	MN -95d	10:22505
DOE/R3/08064-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85009397	MN -61E	10:22507
DOE/R3/08069-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85009161	MN -97e	10:22510
DOE/R3/08072-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009209	MN -59B	10:22576
DOE/R3/08074-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009189	MN -95d	10:22790
DOE/R3/08075-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85009163	MN -61	10:22810
DOE/R3/08077-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009389	MN -95f	10:22811
DOE/R3/08086-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009513	MN -95	10:22820
DOE/R3/08097-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009380	MN -95	10:23362
DOE/R3/08099-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85009382	MN -61D	10:22791
DOE/R3/88089-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85009391	MN -61	10:22497
DOE/RA/50094-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85009800	MN -66	10:22751
DOE/RA/50276-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85009543	MN -97	10:22607
DOE/RA/50570-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008641	MN -97	10:22618

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
DOE/RG/10366-					
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008668	MN -97	10:22610
DOE/RL/01830-					
16	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008486	MN -95d	10:22792
DOE/S-					
0033	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99:	DE85011094	MN -98	10:22415
DOE/SF/11564-					
10	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85000127	STD -92a	10:22368
DOE/TIC-					
3311-S13-Pts.1and2	NTIS PC $41.00/MF A01 (GPO Dep.)	E 1.99:	DE84013531	STD -70	10:22455
3359-Suppl.2	*See* DOE/METC-85/15	E 1.99:	DE85004565	STD -93A	10:22760
3392-Suppl.1	NTIS PC $8.50/MF A01 (GPO Dep.)	E 1.99:	DE85008190	STD -70	10:22424
DOE-tr-					
273-Vol.1	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007039	MN -93	10:22757
273-Vol.2	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007038	MN -93	10:22758
DP-MS-					
84-116-Rev.12-84	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007908	MN -41	10:23149
84-118	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007910	MN -11	10:23069
84-122	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85003659	MN -70	10:22425
84-127	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85005860	MN -70	10:22426
85-10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008257	MN -25	10:22839
DPST-					
84-649	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009486	MN -70	10:22427
85-263	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010062	MN -70	10:22428
85-264	NTIS, PC A03; 3		DE85009489	MN -70	10:22429
85-265	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009487	MN -70	10:22430
85-285	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010225	MN -11	10:23085
E-					
85-10022	*See* N-85-11435				10:22732
2149	*See* N-85-10065				10:22963
2156	*See* N-85-10165				10:22841
2351	*See* N-85-11133				10:22528
ECON-					
82-180-1	*See* PB-85-150340/XAB				10:22637
EEB-W-					
84-08	*See* LBL-16073	E 1.99:	DE85008585	MN -95d	10:22795
85-01	*See* LBL-17457	E 1.99:	DE85009933	MN -95d	10:22796
EEC-					
154	NTIS (US Sales Only), PC A04/MF A01		DE85900588	MN -38	10:22971
156	NTIS (US Sales Only), PC A05/MF A01; 1		DE85900453	MN -59B	10:22793
EGG-					
1183-1226	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009042	MN -32	10:23000
2357	*See* NUREG/CR-4046		TI85009842	MN -78	10:22707
02184	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008651	MN -70	10:22431
EGG/10282-					
1049	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010005	STD -41	10:23094
1063	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010134	STD -41	10:23095
1077	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008644	MN -37	10:23042
2060	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009677	MN -22	10:22405
4035	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009874	MN -37	10:23043
EGG-EA-					
6652-Rev.1	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	E 1.99:	TI85008015	MN -78	10:22641
6734	NTIS, PC A02/MF A01 - GPO		TI85009883	MN -78	10:22642
6737	NTIS, PC A03/MF A01 - GPO		TI85009886	MN -80	10:22673
6766	NTIS, PC A02/MF A01 - GPO		TI85009616	MN -78	10:22643
6797	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008041	MN -70	10:22432
6815	NTIS, PC A04/MF A01 - GPO		TI85009724	MN -80	10:22674
EGG-IS-					
6494(2-85)	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009171	MN -32	10:23378
EGG-M-					
02084	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008582	MN -70B	10:22433
04185	NTIS, PC A02; 3		DE85009175	MN -78	10:22675
04785	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009109	MN -11	10:23180
06285	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008936	MN -95f	10:22812
08785	NTIS, PC A02; 3		DE85009878	MN -70	10:22434
21284	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008648	MN -70	10:22435
25184	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008935	MN -38	10:22972
EGG-PBS-					
6731	NTIS, PC A02/MF A01 - GPO		TI85009920	MN -70B	10:22436
6808	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE85009927	MN -20	10:23337
EGG-RST-					
6791	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008007	MN -78	10:22676
6803	NTIS, PC A03/MF A01 - GPO		TI85008437	MN -78	10:22626
6811	NTIS, PC A06/MF A01 - GPO		TI85009723	MN -78	10:22630
EGG-SE-					
6752	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008933	MN -96	10:22827
EGG/SE-M-					
84-006	*See* EGG-M-04785	E 1.99:	DE85009109	MN -11	10:23180
EGG-SEMI-					
6809	NTIS, PC A03/MF A01 - GPO		TI85008646	MN -78	10:22677
6813	NTIS, PC A05/MF A01 - GPO		TI85009928	MN -78	10:22678
6830	NTIS, PC A03/MF A01 - GPO		TI85009884	MN -78	10:22679
EGG-TFBP-					
6739	NTIS, PC A03/MF A01 - GPO		TI85009174	MN -80	10:23044

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EGG-WRR-6784	NTIS, PC A07/MF A01 - GPO		DE85008688	MN -2	10:22680
ENV-MER-81-188	NTIS (US Sales Only), PC A06; 3		DE85751005	MN -58	10:22752
81-308	NTIS (US Sales Only), PC A06; 3		DE85751001	MN -59A	10:22577
EPA-450/ 2-84/ 006	*See* PB-85-140630/XAB				10:23088
560/ 5-83-012-Vol.6-Pt.2	*See* ORNL/EIS-163-Vol.6-Pt.2	E 1.99:	DE85008767	MN -48	10:23109
600/ D-84/ 276	*See* PB-85-124642/XAB				10:23006
EPA/600/3-84/ 107	*See* PB-85-137354/XAB				10:23093
EPRI-AP-3825-SR	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $64.00		TI85920574	ND -90d	10:22292
3853-Vol.2	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $11.50		TI85920575	ND -21	10:23338
3865	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $13.00		TI85920506	ND -61D	10:22480
3910	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $11.50		TI85920517	ND -90f	10:22352
3980	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $17.50		TI85920577	ND -90f	10:22293
EPRI-CS-3808	Research Reports Center, P.O. Box 50490, Pao Alto, CA 94303, $17.50		TI85920545	ND -90b	10:22341
3812	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $16.00		TI85920581	ND -90e	10:22353
3901-Vol.1	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303		TI85920571	ND -90i	10:23173
3923	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $26.50		TI85920579	ND -90i	10:22322
EPRI-EA-3805-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303, $17.50		TI85920548	ND -97c	10:22747
3857-CCM	Research Reports Center, Box 50490, Palo Alto, CA 94303, $23.50		TI85920551	ND -97	10:22748
3890-Vol.1	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $8.50		TI85920513	ND -97	10:22611
3904	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $10.00		TI85920572	ND -41	10:23169
3917	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $11.50		TI85920546	ND -41	10:23170
3920-Vol.2	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $25.00		TI85920570	ND -90i	10:23152
EPRI-EL-3893	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $10.00		TI85920573	ND -97	10:22749
3961	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $8.50		TI85920532	ND -97a	10:22619
EPRI-NP-2956	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $14.50		TI85920564	ND -78	10:22681
3847	Research Reports Center, Box 50490, Palo Alto, CA 94303, $8.50		TI85920521	ND -80	10:22631
3850	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $13.00		TI85920558	ND -78	10:22682
3858	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $17.50		TI85920578	ND -78	10:22683
3870	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $13.00		TI85920539	ND -78	10:22684
3871	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $14.50		TI85920533	ND -78	10:22685
3916	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $14.50		TI85920510	ND -80	10:22686
3926	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $16.00		TI85920523	ND -78	10:22627
3940	NTIS, PC A05/MF A01 - Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50 (GPO Dep.)	E 1.99:	DE85009725	MN -78	10:22632
3942	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $10.00		TI85920559	ND -78	10:22633
3948	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $11.50		TI85920568	ND -80	10:22687
EPRI-RP-1748	*See* EGG-PBS-6808	E 1.99:	DE85009927	MN -20	10:23337
ESG-82-41	*See* DOE/AL/16333-1	E 1.99:	DE85009038	MN -62	10:22559
ESG-DOE-13507	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008686	STD -70A	10:22437
EUR-9396-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037				10:22354

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FCR-					
6494	*See* PB-85-151322/XAB				10:22763
FES-					
75-79-Vol.1	NTIS, PC A25/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010086	MN -97	10:22614
FNAL/C-					
84/ 135	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009537	MN -34B	10:23184
FOA-C-					
10246-M5	*See* PB-85-146249/XAB				10:22727
20563-D3	*See* PB-85-146223/XAB				10:22965
FRNC-TH-					
1615	NTIS (US Sales Only), PC A07; 3		DE85751010	MN -92	10:22396
1616	NTIS (US Sales Only), PC A12; 3		DE85751009	MN -59A	10:22581
1617	NTIS (US Sales Only), PC A12; 3		DE85751004	MN -59A	10:22518
1618	NTIS (US Sales Only), PC A06; 3		DE85751012	MN -94ca	10:22722
1706	NTIS (US Sales Only), PC A11; 3		DE85751008	MN -63	10:22525
1715	NTIS (US Sales Only), PC A08; 3		DE85751007	MN -90a	10:22294
1722	NTIS (US Sales Only), PC A09; 3		DE85751006	MN -95d	10:22794
1726	NTIS (US Sales Only), PC A07; 3		DE85751002	MN -90a	10:22314
1727	NTIS (US Sales Only), PC A10; 3		DE85751003	MN -95	10:23091
GC-TR-					
84-385	*See* AD-A-149041/6/XAB				10:22939
GEND-INF-					
60-Vol.3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008020	MN -78	10:22634
GJ/TMC-					
18	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85008474	STD -70A	10:22438
HEDL-					
7430	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007778	MN -79r	10:22663
HEDL-SA-					
3169-FP	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008553	MN -80	10:22655
3181-FP-Draft	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007464	MN -20c	10:23339
HI-					
3113-RR	*See* AD-A-149469/9/XAB				10:22735
HNEI-					
84-S02	NTIS, PC A03/MF A01; 1		DE85901276	MN -61	10:22526
HRP-					
0906254/ 8/ XAB	NTIS, PC A03/MF A01				10:23045
IAEA-CN-					
45	*See* BNL-36194	E 1.99:	DE85009767	MN -48	10:23107
IEA/ICEAS/E-					
3/ 2	NTIS (US Sales Only), PC A05/MF A01		TI85901170	MN -90d	10:22295
7	NTIS (US Sales Only), PC A05/MF A01		TI85901290	MN -90c	10:22498
IFSR-					
168	*See* DOE/ET/53088-168	E 1.99:	DE85010085	MN -20	10:23300
IIES-pre-					
83-9	NTIS (US Sales Only), PC A02/MF A01		DE85751511	MN -98F	10:22726
IMMR-					
82/ 068	*See* PB-85-139137/XAB				10:22399
82-077	*See* PB-85-126308/XAB				10:22359
83-080	*See* PB-85-149128/XAB				10:22331
INDC(USA)-					
95	*See* DOE/NDC-35	E 1.99:	DE85009974	MN -22	10:22471
IPD-ISO-					
1011	Department of Scientific and Industrial Research, Industrial Processing Division, Petone, New Zealand				10:22274
IS-T-					
1001	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009226	MN -4	10:22945
JPL-					
9950-935	*See* N-85-10446				10:22527
9950-970	*See* DOE/CS/54209-25	E 1.99:	DE85006661	STD -96	10:22826
Juel-Spez-					
249	NTIS (US Sales Only), PC A11/MF A01; 1		DE85751513	MN -60	10:22593
K-					
2041	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009506	MN -38	10:22406
K/CSD/TM-					
53	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009802	STD -32	10:23224
K/PS-					
5025	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009017	MN -22	10:22407
KMSF-U-					
1526	*See* AD-A-148951/7/XAB				10:22985
LA-					
9700-MS	*See* NUREG/CR-3208		TI85008894	MN -78	10:22698
10265	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008908	STD -41	10:22401
10272-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010325	STD -34A	10:23275
10298-T	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008910	STD -32	10:23367
10327-PR	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010324	STD -11	10:23102
LA-tr-					
85-17	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009980	MN -34A	10:22880
LA-UR-					
84-1680	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008629	MN -59A	10:22578
84-1745	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008628	MN -59A	10:22582
85-16	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85005907	MN -32	10:23368
85-752	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009591	MN -20d	10:23340
85-753	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009592	MN -20	10:23341
85-785	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009570	MN -70B	10:22439

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85-802	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009572	MN -48	10:23131
85-837	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009577	MN -34D	10:23236
85-848	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009578	MN -34	10:23225
85-854	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009579	MN -32	10:23019
85-882	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009547	MN -28	10:23009
85-884	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009549	MN -66b	10:23005
85-954	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009569	MN -28	10:23012
85-962	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009568	MN -20d	10:23342
85-983	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009636	MN -20d	10:23343
85-1021	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009630	MN -28	10:23013
85-1066	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009595	MN -25	10:22892
85-1092	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009601	MN -34D	10:23249
85-1114	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009604	MN -45	10:23049
85-1129	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009608	MN -45	10:23050
LBL-					
16073	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85008585	MN -95d	10:22795
17457	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009933	MN -95d	10:22796
18255	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008446	MN -25	10:22840
18651	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008515	MN -4	10:22950
18716	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85006869	STD -94c	10:22723
18945	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85009968	MN -28	10:23022
18947	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008442	MN -92a	10:22369
19032	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009937	MN -34C	10:23270
19064	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008455	MN -28	10:23014
19092	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008680	MN -66a	10:22590
19106	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008683	MN -11	10:23101
19195	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008678	MN -34D	10:23237
19276	NTIS, PC A11/MF A01 (GPO Dep.)	E 1.99:	DE85009929	MN -48	10:23108
19287	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009897	MN -34D	10:23238
LC-					
84-601023	*See* N-85-11491				10:23176
LIS-					
34	NTIS (US Sales Only), PC A03/MF A01; 1		DE85751512	MN -11	10:23070
LYCEN-					
8356	NTIS (US Sales Only), PC A02/MF A01		DE85901228	MN -34A	10:23284
MIT/EL-					
84/ 007	*See* PB-85-144244/XAB				10:22615
84/ 008	*See* PB-85-144269/XAB				10:23099
84/ 011	*See* PB-85-144251/XAB				10:22711
84/ 014	*See* PB-85-142693/XAB				10:22710
84/ 018	*See* PB-85-142735/XAB				10:22636
MLM-					
3234	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010209	STD -22	10:22472
N-					
85-10065	NTIS, PC A03/MF A01				10:22963
85-10164	NTIS, PC A02/MF A01				10:22930
85-10165	NTIS, PC A11/MF A01				10:22841
85-10166	NTIS, PC A05/MF A01				10:22842
85-10444	NTIS, PC A04/MF A01				10:22724
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85-11455	NTIS, PC A06/MF A01				10:22761
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85-11923	NTIS, PC A02/MF A01				10:23187
85-11932	NTIS, PC A99/MF A01				10:23188
85-13304	California Inst. of Tech., Pasadena				10:23174
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85-13559	NTIS, PC A02/MF A01				10:23207
85-13560	NTIS, PC A03/MF A01				10:23037
NASA-CR-					
167870	*See* N-85-10993				10:22828
171183	*See* N-85-10164				10:22930
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77514	*See* N-85-10458				10:23171
77594	*See* N-85-10887				10:23185
77595	*See* N-85-10843				10:22973
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2372	*See* N-85-10065				10:22963
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85-3111	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009683	MN -97	10:22620
85-3112	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009682	MN -97	10:22621
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1709	*See* AD-A-148884/0/XAB				10:22499
NCI/ICRDB/OT-					
84/ 08	*See* PB-84-922808/XAB				10:23132
NEANDC(US)-					
220	*See* DOE/NDC-35	E 1.99:	DE85009974	MN -22	10:22471
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2-69-1112-Vol.1	NMERDI-Univ. of New Mexico, Suite M 457 Washington SE, Albuquerque, NM 87108		TI85901171	MN -70	10:22440
2-69-1112-Vol.2	NMERDI-Univ. of New Mexico, Suite M 457 Washington SE, Albuquerque, NM 87108		TI85901279	MN -70	10:22441
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4901496	NTIS (US Sales Only), PC A12/MF A01; 1		DE84901496	MN -88	10:22336
4901586	NTIS (US Sales Only), PC A03/MF A01; 1		DE84901586	MN -90h	10:22844
4901622	NTIS (US Sales Only), PC A04/MF A01		DE84901622	MN -95f	10:22813
4901629	NTIS (US Sales Only), PC A03/MF A01; 1		DE84901629	MN -90j	10:22907
5770251	NTIS (US Sales Only), PC A12/MF A01; 1		DE85770251	MN -90	10:22356
5900586	NTIS (US Sales Only), PC A14/MF A01; 1		DE85900586	MN -95d	10:22797
5901251	SOMED-Univ. of Alabama, P.O. Drawer AY, University (Tuscaloosa), AL 35486		TI85901251	MN -13	10:22397
5901253	Technical Information Exchange, Bldg. 5, Room 321, Schenectady, NY 12345		TI85901253	MN -38	10:22845
5901291	Kansas Geological Survey, Univ. of Kansas, 1930 Constant Ave., Lawrence, KS 66046		TI85901291	MN -92a	10:22376
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67	*See* PB-85-147155/XAB				10:22975
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20600	National Research Council of Canada, Halifax, Nova Scotia				10:22296
22858	National Research Council of Canada, Halifax, Nova Scotia				10:22328
22859	National Research Council of Canada, Halifax, Nova Scotia				10:22357
23014	National Research Council of Canada, Halifax, Nova Scotia				10:22275
23015	National Research Council of Canada, Halifax, Nova Scotia				10:22358
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5515	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008244	MN -20d	10:23344
5528	*See* NUREG/CR-3990		TI85901281	MN -78	10:22705
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5387	*See* AD-A-148106/8/XAB				10:23011
5471	*See* AD-A-149052/3/XAB				10:22987
5482	*See* AD-A-148904/6/XAB				10:23273
NSF/PRA-					
82013	*See* PB-85-150316/XAB				10:23089
NSWC-TR-					
82-416	*See* AD-A-148673/7/XAB				10:22719
NUREG-					
0430-Vol.5-No.1	NTIS, PC A02/MF A01 - GPO		TI85901327	MN -15	10:22469
0540-Vol.7-No.1	NTIS, PC A99/MF A01 - GPO*		TI85901301	MN -2	10:22644
0606-Vol.7-No.1	NTIS, PC A05/MF A01 - GPO*		TI85901173	MN -80	10:22688
0675-Suppl.30	NTIS, PC A07/MF A01 - GPO $5.50		TI85901300	MN -78	10:22689
0787-Suppl.10	NTIS, PC A03/MF A01 - GPO $3.75		TI85901248	MN -78	10:22690
0798-Suppl.5	NTIS, PC A09/MF A01 - GPO* $6.00		TI85901349	MN -78	10:22691
0905	NTIS, PC A03/MF A01 - GPO* $3.75		TI85901263	MN -78	10:22692
1031-Suppl.1	NTIS, PC A05/MF A01 - GPO $4.75		TI85901289	MN -78	10:22693
1048-Suppl.1	NTIS, PC A05/MF A01 - GPO* $4.50		TI85901243	MN -78	10:22694
1089	NTIS, PC A22/MF A01 - GPO $10.00		TI85901282	MN -78	10:22695
1096	NTIS, PC A04/MF A01 - GPO $4.50		TI85901203	MN -80	10:22696
1104	NTIS, PC A21/MF A01 - GPO* $9.50		TI85901223	MN -78	10:22645
1117	NTIS, PC A21/MF A01 - GPO* $10.00		TI85901172	MN -78	10:22697
1130	NTIS, PC A03/MF A01 - GPO $3.75		TI85901224	MN -15	10:22470
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3611	NTIS, PC A03/MF A01 - GPO		TI85010382	MN -71	10:22465
3647	NTIS, PC A07/MF A01 - GPO		TI85009909	MN -78	10:22699
3659	NTIS (US Sales Only), PC A03/MF A01 - GPO $4.00		TI85008128	MN -78	10:22635
3709	NTIS, PC A08/MF A01 - GPO $5.50		TI85010011	MN -51	10:22460
3802	NTIS, PC A02/MF A01 - GPO		TI85008159	MN -78	10:22700
3805-Vol.2	NTIS, PC A08/MF A01 - GPO $5.50		TI85901169	MN -80	10:22701
3810-Vol.3	NTIS, PC A03/MF A01 - GPO $3.75		TI85008387	MN -78	10:22702
3913	NTIS, PC A14/MF A01 - GPO		TI85009520	MN -78	10:22703
3954	NTIS, PC A07/MF A01 - GPO		TI85008508	MN -80	10:22704
3990	NTIS, PC A09/MF A01 - GPO $6.00		TI85901281	MN -78	10:22705
3998-Vol.2	NTIS, PC A05/MF A01 - GPO		TI85009687	MN -78	10:22706
4046	NTIS, PC A02/MF A01 - GPO		TI85009842	MN -78	10:22707
4061	NTIS PC E02/MF A01 - GPO $5.50		TI85009618	MN -70	10:22442
4070-Vol.2	NTIS, PC A04/MF A01 - GPO $4.50		TI85008532	MN -80	10:22660
4120	NTIS, PC A12/MF A01 - GPO $7.00		TI85009747	MN -80	10:22708
4172	NTIS, PC A03/MF A01 - GPO* $4.00		TI85901264	MN -80	10:22709
4174	NTIS, PC A17/MF A01 - GPO		TI85901304	MN -70	10:22443
4180	NTIS, PC A06/MF A01 - GPO		TI85008674	MN -80	10:22656
NVO-					
209-Rev.5	NTIS, PC A05/MF A01, 1 (GPO Dep.)	E 1.99:	DE85010215	STD -2	10:23058
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118-Vol.2	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE85005407	MN -70	10:22444
ORNL-					
6089-Vol.4	NTIS, PC A19/MF A01; 1		DE85009658	MN -20	10:23208
6156	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010138	MN -41	10:23150
ORNL/CSD/TM-					
225	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008765	MN -41	10:22466
ORNL/EIS-					
163-Vol.6-Pt.2	NTIS, PC A21/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008767	MN -48	10:23109
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83/ 9	NTIS, PC A25/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010208	STD -20d	10:23345
84/ 10	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010451	STD -20d	10:23346
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82-22293/ 2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009988	MN -95d	10:22798
7676/ 5	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010035	MN -20f	10:23301
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9016	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85009779	STD -25	10:22846
9448	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008752	MN -80	10:22664
9468	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009455	MN -80	10:22665
9478	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010211	STD -20f	10:23209
9504	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009671	STD -20g	10:23347
9552	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009458	MN -80	10:22666
9571	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85010210	STD -4	10:22964
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5192	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007719	MN -4	10:22938
5197	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007853	MN -20	10:23324
5199	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009981	MN -25	10:22887
5201	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009977	MN -25	10:22886
5206	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008574	MN -11	10:23087
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3631-13-Pt.1	*See* DOE/EV/03631-13-Pt.1	E 1.99:	DE85008667	MN -48	10:23147
3631-13-Pt.2-Rev.	*See* DOE/EV/03631-13-Pt.2-Rev.	E 1.99:	DE85008934	MN -48	10:23148
4049-4	*See* DOE/ER/04049-4	E 1.99:	DE85009472	MN -25	10:22903
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85-121713/ XAB	NTIS, PC A02/MF A01				10:22381
85-122232/ XAB	NTIS PC B04/MF B01				10:22382
85-122687/ XAB	NTIS, PC A02/MF A01				10:22329

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85-124154/ XAB	NTIS, PC A08/MF A01			10:22823
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85-126126/ XAB	NTIS, PC A21/MF A01			10:22824
85-126308/ XAB	NTIS, PC A04/MF A01			10:22359
85-129864/ XAB	NTIS PC E03/MF E01			10:22908
85-129872/ XAB	NTIS PC E03/MF E01			10:22909
85-135846/ XAB	NTIS PC E06/MF E01			10:22799
85-136745/ XAB	NTIS, PC A07/MF A01			10:22481
85-137107/ XAB	NTIS, PC A12/MF A01			10:23071
85-137354/ XAB	NTIS, PC A16/MF A01			10:23093
85-137800/ XAB	NTIS, PC A13/MF A01			10:22506
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85-138105/ XAB	NTIS, PC A05/MF A01			10:22366
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85-139202/ XAB	NTIS, PC A04/MF A01			10:23175
85-139228/ XAB	NTIS PC E12/MF E01			10:22733
85-139426/ XAB	NTIS PC E08/MF E08			10:22323
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85-140184/ XAB	NTIS, PC A11/MF A01			10:22482
85-140630/ XAB	NTIS, PC A11/MF A01			10:23088
85-140879/ XAB	NTIS PC E05/MF E05			10:22800
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85-142693/ XAB	NTIS, PC A07/MF A01			10:22710
85-142727/ XAB	NTIS, PC A02/MF A01			10:23137
85-142735/ XAB	NTIS, PC A04/MF A01			10:22636
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85-144244/ XAB	NTIS, PC A09/MF A01			10:22615
85-144251/ XAB	NTIS, PC A22/MF A01			10:22711
85-144269/ XAB	NTIS, PC A07/MF A01			10:23099
85-144293/ XAB	NTIS PC E06/MF E06			10:22814
85-145134/ XAB	NTIS, PC A04/MF A01			10:23072
85-145720/ XAB	NTIS, PC A03/MF A01			10:23133
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85-161941/ XAB	NTIS, PC A11/MF A01			10:22488
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5027	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009946	MN -95d	10:22802
5106-3-Vol.3	*See* NUREG/CR-3810-Vol.3		TI85008387	MN -78	10:22702
5237	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85009792	MN -70	10:22445
5300-Vol.2	*See* NUREG/CR-4070-Vol.2		TI85008532	MN -80	10:22660
5318	*See* NUREG/CR-4061		TI85009618	MN -70	10:22442
5319	*See* NUREG/CR-3709		TI85010011	MN -51	10:22460
5341	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85009667	MN -70	10:22847
5415	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE85009778	MN -41	10:23151
5500-Pt.1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009365	MN -48	10:23153
5500-Pt.2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010099	MN -11	10:22734
5500-Pt.3	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85009666	MN -11	10:23073
5500-Pt.4	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85009285	MN -48	10:23154
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12441	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85005289	MN -41	10:22467
12550	NTIS, PC A02/MF A01 - GPO		TI85007406	MN -78	10:22712
12569	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009433	MN -70B	10:22461
12571	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009430	MN -70	10:22446
12584	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007501	MN -80	10:22713
12586	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009434	MN -86	10:22409
12614	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009316	MN -70	10:22447
12626	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009128	MN -71	10:22977
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J Journal article
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RA Report analytic
B Book
BA Book analytic
P Patent
E Engineering materials
D Thesis or dissertation
TG Translation (general)
TA Translation (analytic)

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UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG Uganda
US United States of America (USA)
UY Uruguay

VA Holy See
VD Democratic Republic of Vietnam
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VS Republic of Vietnam

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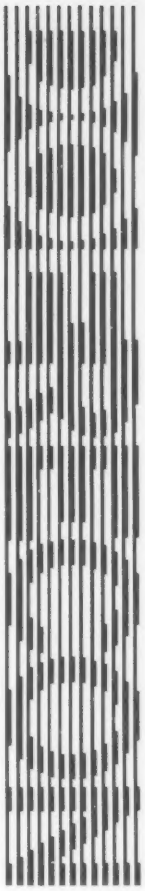

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